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SODIUM AS A SUBSTITUTE FOR COPPER IN ELECTRIC CONDUCTORS.

The article which we print elsewhere, by Mr. Anson G. Betts, on the use of sodium as conductor in place of copper, will doubtless bring surprise to many of our readers. Most persons would as soon think of using a wire of sodium as a wire of mercury. Nevertheless, the facts and figures speak for themselves. As for the resistivity of sodium, it is not to be found in the tables of resistivities printed in the ordinary text-books on physics, either pure or applied, and most electrically-occupied persons do not know what the resistivity of sodium is, or whether this quantity has ever been measured.

It will be recalled that when aluminum was first suggested as a possible economical substitute for copper in conductors, the idea came as a surprise to many, for the reason that its resistivity is two-thirds again as much as that of copper. But aluminum weighs one-third as much as copper; so that it stands on a par with copper as an electric conductor in regard to cost of material, when its price per pound or kilogramme is double that of copper. That is, aluminum at forty cents per pound is just about the equivalent, in conductance, to copper at twenty cents per pound, leaving out of consideration the relative costs of erection and of maintenance. In the case of sodium, now proposed, its resistivity, according to Mr. Betts, is about three times that of copper, but its specific gravity is one-ninth as great; so that a wire of sodium weighing, say, one pound to the linear foot, would conduct about three times better than a copper wire also weighing one pound per foot. Consequently, sodium as an electric conductor would be on a par with copper, in regard to first cost of conducting material, when the price per pound of sodium was about three times that of copper. If then sodium had mechanical, physical and chemical properties identical with copper, so that a sodium wire could be used just as conveniently as a copper wire, sodium wires would be as cheap as copper wires with sodium selling at sixty cents per pound and copper at twenty. Mr. Betts points out, however, that sodium might be expected to be produced as low as 7½ cents per pound, although it cannot be obtained at that price to-day. At such a price sodium for conductors would be theoretically about one-sixth as expensive as copper at fifteen cents per pound.

We all know, however, that the physical, mechanical and chemical properties of sodium differ very markedly from those of copper. Sodium is a very soft, lustrous metal, easily cut with a knife. It floats on water, with a specific gravity of 0.98 and melts at 95° C. It is set fire to by being thrown on water. The only hope of securing a wire of sodium that can be used is to make a composite wire, with the sodium inside. Mr. Betts adopted the plan of running molten sodium into wrought-iron pipes tightly closed with screw caps of cast iron containing copper bolts. It would seem that in the case of the wrought-iron pipes described, of 1½ in. nominal internal diameter, filled with sodium, the conductance of the sodium should be about 80 per cent of the total, and that of the iron pipe about 20 per cent. That is, the current carried by the iron should only be about one-

fifth of the current carried by the composite conductor, so that if the sodium failed to carry the current the electric test by fall of potential would soon reveal the fact. It is interesting to learn that the sodium made good contact with the iron and carried its share of current. Since sodium forms alloys with most metals, combining with them, and liberating heat in the process, prolonged tests would seem to be needed to make sure that the composite wrought-iron-sodium conductors were permanent, and did not undergo slow chemical alteration. This question and a number of others, such as the relative expansions of sodium and iron, the temperature coefficient of resistivity, etc., will be opened up by the article referred to, which is worthy of careful consideration. As the author points out, sodium conductors would distinctly increase fire hazard in buildings. It may be accepted, therefore, that the use of sodium conductors would have to be limited to underground work in open streets or roadways. One comfort about sodium as a conductor would be that there is no danger of exhausting the world's supply of sodium chloride, the mother substance. The amount held in stock by the oceans would last a sufficient length of time to satisfy the most pessimistic views.

Constant Direct-Current Dynamos.

Our issue for July 15, 1905, contained a description of an interesting direct-current dynamo, the predominating characteristic of which is that it delivers a practically constant current throughout a wide range of armature speed. The dynamo described is particularly well suited for train lighting, and its use for this purpose was mentioned in the issue referred to above. The present issue contains an article by the inventor of this type of dynamo, in which additional information is given concerning the constructional features of the machine and its use for delivering almost constant current or constant power under extreme conditions of service. Although some slight changes have been made in the magnetic circuit of the machine in order to render it suitable for the exact conditions of operation, the fundamental characteristics of the machine are the same in each case, quite independent of the service for which it is intended. The machine will, throughout a limited range when the external local resistance is relatively large, tend to maintain an approximately constant e.m.f. independent of the load when the speed is constant; or throughout a different limited range of load resistance, the machine will deliver a practically constant amount of power; and when the load resistance is relatively small, the current of the machine as a dynamo or booster is closely constant. As a constant-voltage dynamo, the machine could, under no circumstance, compete with the familiar shunt-wound or compound-wound direct-current generator; but as a constant-power or constant-current machine, it appears to possess peculiar advantages with reference to simplicity over other types of direct-current generators.

Dr. Rosenberg has pointed out the methods which should be employed in order to enlarge the constant-power or the constant-current range, as desired, or to render the machine particularly useful for any required duty. When designed for constant-current, the machine can be employed for operating arc lamps, and is especially advantageous for use with a single arc lamp, in which case almost no regulating mechanism is required. As a constant-power dynamo, the machine is directly applicable for electric welding, in which case neither fuses nor circuit-breakers are necessary. Perhaps the most interesting use of the machine is found in its operation as an automatic booster. In this connection it is instructive to observe that when the familiar form of constant-potential, direct-current generator is used with a storage battery "floating" upon the system, the division of load between the battery and the generator will depend largely upon the amount of resistance included in the connecting circuits. The principal advantage of a booster resides in the elimination of the large losses in the resistance which must be used if the load upon the generator is to remain practically constant. It would seem that with a Rosenberg booster the current from the generator could not fluctuate widely even under the most adverse conditions, and that the load on the generator would be held constant within a very few per cent whether the battery was fully charged and doing no external work and thereby possessing a high counter e.m.f., or was practically exhausted and its counter voltage very low. The usefulness of the machine in train lighting seems to have been demonstrated by satisfactory results obtained on a number of railways, while the fact that no auxiliary commutating poles or similar devices have been employed or seriously contemplated, is sufficient evidence that the sparking difficulties have not been great.

Compensated Direct-Current Dynamos.

It has been pointed out by various dynamo constructors, at different times, that the ordinary uncompensated direct-current machine expends an inordinately large excitation upon its main field, compared with many alternating-current machines, such as induction motors. The ordinary uncompensated direct-current shunt machine has to keep its main flux substantially unchanged in total amount between no load and full load, so that the armature distortion must not reduce the generated voltage appreciably at full load. But in the compensated types of direct-current machine, in which an auxiliary field winding is applied to cancel or annul the m.m.f. of the armature under load, a greatly reduced air-gap and main field excitation may serve to maintain the voltage under all conditions of load. A paper has recently been read by Herr E. Ziehl before the Elektrotechnischer Verein in Berlin, as abstracted in this week's Digest, which deals with the essential differences in construction between alternating-current induction motors and direct-current motors. The author points out that the output per pound of induction motors exceeds that of ordinary direct-current machines, owing to the small air-gap and to the excellent disposition of copper and iron in induction motors. He then considers the changes which would be rendered necessary in order to convert an induction motor into a direct-current machine. In this way, by using a stator ring field, enclosing a rotor armature and commutator, a direct-current machine is developed which, except for the commutator, might be taken for an induction motor. The field winding is composite and arranged so as to compensate the armature m.m.f. at all loads.

The paper shows that proceeding along these lines it is possible to construct machine frameworks, or skeleton frames of stator and rotor, which may be adapted to becoming either a direct-current machine or an alternating-current induction machine, or a converter, according to the particular winding applied, with or without a commutator. The output of the machine is substantially the same whether a direct-current winding and commutator is used for a direct-current motor or whether an alter-

nating-current winding and slip-rings are used for an induction motor. In fact, the output is indicated as being slightly greater in the direct-current construction. An advantage of such a method of construction would be a simplification of parts, whereby standardization would be more readily effected. There would also be a more logical mode of procedure than exists at present. Many claim, however, that the induction motor type of direct-current machine construction would cost more to build than the present types, on account of the increased amount of laminated steel required.

HIGH EFFICIENCY INCANDESCENTS.

We have learned to look to the Bureau of Standards for research work of a very high order, and it is with great pleasure that we call attention to the paper by Waidner and Burgess which is published elsewhere in our columns. The direct aim of the research was to determine the relative importance of temperature and of selective radiation in producing the very high efficiencies found in the recent metallic filament incandescent lamp. We have always assumed them to be due to temperature, judging from the general physical and chemical character of the radiating bodies, but the authors note the frequent expression of doubts on this point and may be said to have once for all settled the matter. The method employed was that of optical pyrometry fully described in the paper. This method has been sufficiently tried to give one no small degree of confidence in the results, unless in extreme cases of extrapolation above the temperatures available with carbon. Even when, as in case of the over-run tungsten lamps, extrapolation has to cover a wide range, the relative temperatures corresponding to the several color radiations can hardly be much in error even if the absolute temperature be regarded as merely approximate. The general result of the investigation is conclusive in showing that temperature is the controlling factor in the high efficiencies found, selective radiation being altogether subsidiary under working conditions. In other words, the metals behave, if not exactly like black bodies, still nearly enough like them to show no especial gain or loss for practical purposes. Apparently selective radiation must be sought among the metallic oxides rather than among the metals themselves, which, in fact, is being taken advantage of in some of the composite filaments with which our European *confreres* are actively experimenting. Metallic alloys as such, being generally inferior to either of the components in melting point, are unlikely to be of great service in lamp filaments.

It plainly appears from the experiment that the variations in character of radiation between two metallic filaments nominally the same are quite as noticeable as the variation of either from a true black body radiator. Two tungsten filaments, for example, may show perceptible variations in radiation according to their physical character, and the same filament may show variations after use. It would be interesting to know how far such difference may be due to different methods of preparing the filament. As the tungsten filament is an agglomeration, in any case it is easy to see that treatment before or after completion of the lamps might produce minor variations in the character of the radiating surface. In case of the tantalum lamp, which has a true metallic filament, the extremely interesting fact was brought out that while the radiation changed somewhat with overheating, a rest of ten days brought the lamp nearly to its initial condition. The blackening of the bulb in the tantalum lamp, by the way, is a very curious phenomenon which deserves very careful investigation. It sometimes occurs in a marked degree under normal running conditions and after a brief period, as well as at extremely high temperature. It looks very much as though the tantalum filament had not yet been brought to uniformity of manufacture. Small impurities doubtless produce as large variations in physical properties in tantalum as in other metals, and the processes of separation in preparing tantalum have very probably not yet been perfected. The extreme brittleness acquired by the filaments under certain conditions is evidence of this, since it is in apparent contradiction of the more general properties of the metal. It would be most interesting to know whether the current-temperature equations for tantalum are subject to any considerable variations as in the case of tungsten. The two equations given in the paper are much closer together than any pair of the tungsten equations, as indeed would *a priori* be expected, but the amount of variation shown by a series of commercial lamps is important as evidence upon the uniformity of the product.

Incidentally Waidner and Burgess made preliminary tests of the Nernst glower, showing in confirmation of the work of other experimenters, a strongly selective radiation, as was to be expected from the materials concerned. Touching the question of the apparently very high efficiency of the metallic filaments as against the electric arc of which the crater is indubitably at an immensely higher temperature than the filaments, we think the answer is even simpler than indicated by the authors. Of the total radiation from an arc lamp only a fraction, and in some arcs a small fraction, is from the true high temperature crater. Much of the crater light is actually cut off by the carbons when the arc is short enough to give a very high crater temperature and is replaced in the visible illumination by light from the adjacent cooler parts of the carbon and from the luminous vapors. In the Carbone arc, for example, in which the crater is fully exposed, there is an increase of efficiency to something like the figure corresponding to the temperature, and when the current density in the arc is very high so is the efficiency. The metallic filament lamps are much more efficient than an old-fashioned arc, but that is mainly the fault of the arc. The work here considered should be closely followed up and we note with gratification that the results given are styled preliminary. The experiments should be extended to other varieties of metallic or compound filaments as they appear. Only in this way is it possible to get a clear idea of the progress of manufacture toward a uniform and valuable product. A few days of work on the current-temperature equations will tell more about the progress of the art than months of desultory experience, and particularly more in the direction of improved methods. It would be easy thus to sample metallic filaments so as to secure a uniformly good commercial product, for these are intensely practical tests giving results of immediate value. We hesitate to offer criticism on so admirable a paper as this, but we could wish that the authors had not incidentally helped to perpetuate the erroneous notion that the green rays are most efficacious in illumination. This myth is mainly due to some old experiments by the late Prof. Langley made by what practically amounted to an extinction method, determining merely the luminal sensibility of the eye to color. At all practical values of illumination the maximum luminosity is conspicuously in the yellow, as Sir William Abney has most effectively shown. When cone vision is fairly in action the scene of activity is removed from the green save in the color-blind, and the yellow component of radiation is thereafter the important one.

Close of the Wireless Conference.

Advices from Berlin of Nov. 2 state that the International Wireless Telegraph Conference there closed on that day, the "treaty" or agreement being signed the next day. A special dispatch says: "In the international wireless telegraph conference which finished its work yesterday Great Britain succeeded in making the American proposal for unrestricted exchange of messages between ship and ship and shore, regardless of the system used, a separate article. The international regulation of the use of wireless telegraphy has been satisfactorily settled on the basis of free intercommunication between all the systems, Great Britain at the same time maintaining a free hand to organize a system of its own. Throughout the conference Great Britain was loyally backed by France, Italy and Japan, the French delegates often supporting the British delegates against their own convictions. Italy, from the first, confessed herself inextricably hampered by her contracts with the Marconi Company.

The motion of the United States to make intercommunication between ship and ship compulsory came as a complete surprise to the conference, and was described as a "regular bombshell." The German Government was not particularly pleased with it, but accepted the motion after some hesitation. Great Britain opposed it out of consideration for the demands of traffic on the ground that it was impracticable, besides being an improper restriction to place upon individuals. France, Italy and Japan supported Great Britain, but the motion was carried.

A further proposal by the United States, to make the motion binding on all the signatory powers, which was also opposed by Great Britain, was rejected by the conference, and a British proposal to make the American motion a separate article, to which the powers signing the convention need not necessarily adhere, was passed.

The articles, if all goes well, will go into force July 1, 1908. It is understood that with regard to Article XVII of the draft of the convention the conference came to the conclusion that the only way of settling the question of imposing the convention upon private wireless telegraph companies would be the introduction of special legislation by each State.

A special dispatch to the New York *Evening Post* from its London correspondent says: "The policy of our delegates at the Berlin conference on wireless telegraphy has been bitterly attacked by a powerful section of our press this week. They are accused of having wasted without compensation the advantages of the natural lead which we now possess in our already developed system and our territorial monopoly of convenient naval stations. Even now that the convention is complete and ready for signature, it is hard to say what foundation these charges have or how far they have been dictated by partisans interested in the privileges of the Marconi Company. Reports of the proceedings of the conference are still fragmentary, and such inside information as has been divulged seems to have come almost entirely from interested sources, making it impossible as yet to disentangle any clear summary of results.

"The most controversial point turned on the British reservation, on clause three, whereby our Government claimed to exempt such stations, other than naval or military, as they themselves might select, from the operation of the general agreement of compulsory intercommunication. This reservation was maintained by the British delegates, but subsequently was weakened by private assurances, against which the *Corriere Della Sera* of Milan bitterly complained. This journal, which apparently represents Marconi influences, prophesies litigation between the British Government and that company as to its exclusive rights.

"The *Times's* Berlin correspondent tends to support our supposed concessions and maintains that our liberality will be well repaid in time of war by our familiarity with all systems in use and that the Governmental control of all stations on British territory will secure an immense preponderance for Great Britain in the domain of wireless telegraphy. Great Britain was the chief opponent of the proposal by the United States to make intercommunication compulsory between ship and ship, which was subsequently carried against her by the support of Germany and the small nations of Europe and South America. Canada, who has developed a vast Marconi system at the mouth of the St. Lawrence, complains very reasonably that she deserved a separate representation at the conference."

It would appear from the cable dispatches of November 3 and the above that the representatives of all the powers signed the document but Great Britain, Italy, Japan, Mexico, Persia, and that Portugal did not join in the special article containing one of the United States' proposals—that intercommunication be obligatory between ship and ship. The British delegates some days ago offered as a compromise to accept compulsory intercommunication between ship and ship upon matters pertaining to navigation alone. The United States delegates declined to agree to the compromise, affirming that they were willing to stand or fall on the principle of free intercommunication. They were supported by the great majority of the delegates, who adhered by signature to the article, only those of the six countries named declining. Great Britain, Italy, Japan, France, Spain, Denmark, Persia, Portugal and Turkey did not sign the renunciation privilege, thus excepting from the provisions of the treaty such stations as these governments may select. All the other powers agree to free ship-to-shore intercommunication with all stations open to the public, naval and military stations excepted. The next conference is set for 1911.

The Value of Public Lighting.

At the recent meeting of the Empire State Gas & Electric Association, the secretary, Mr. Rolland A. Davidson, presented an excellent paper on the cost or value of public lighting. The paper is quoted below as follows:

The low prices at which contracts have been made in some cities in this State for city arc lighting have caused considerable comment among central station managers who fear their city governments may expect them to duplicate these prices, some of which are: Buffalo and Utica, $56; Lockport, $55; Amsterdam, $37.50; Little Falls, $35. The above were for 450-watt lamps operated 4,000 hours per year.

It is useless to tell station managers that this is less than cost, for to everybody in the electrical manufacturing business this is a self-evident fact. It is thought, however, that it may be well at this time to consider the question of cost of city lighting to determine approximately what is a fair price for such service. The varying conditions in each locality such as the system in use, cost of producing electricity, either by water or steam power, whether wires are wholly or partly carried in conduits, cost of labor, etc., etc., will all enter into the question of what is a fair price in that particular locality, but the example which I give here is an illustration of what can be done in the ordinary town with a good station and good management.

I have selected as an example a plant equipped with all the modern appliances for economical operation and of about 1,000 kw capacity. This plant generates two-phase, 60-cycle alternating current and supplies commercial lighting and power and the city lighting. The city lighting equipment consists of constant-current transformers of the "tub" pattern, marble switchboard, poles, wires and 6.6-amp., alternating-current enclosed arc lamps to the number of 323. All electricity delivered to the tub transformers is metered. The consumption of electrical energy per arc lamp for a service of 4,000 hours per year is 1,736 kw-hours, on an average of 434 watts per lamp.

It is figured that the investment in that portion of the generating plant required to supply the electricity for city lighting is not less than $25,000.

The investment in tub transformers, switchboard and the portion of the poles and wires devoted to city lighting, and the arc lamps, hoods, etc., amounts to $30,000; making the total investment for city lighting service $55,000.

The cost of electricity at the switchboard varies considerably with different plants. In the plant considered the average for several years would be: For fuel, labor, supplies and repairs per kw-hour, 1.25c.; for insurance, taxes and management, etc., 1.12c.; for 5 per cent interest on $25,000 investment in generating plant, .22c.; for 5 per cent depreciation on same, .22c.; total per kw-hour delivered to the street lighting transformers, 2.81c. The cost per lamp per year is: For 1,736 kw-hours at 2.81c., $48.78; for trimming, patrol and repairs, $8.97; maintenance of

poles and wires, proportion estimated, $5.42; for 5 per cent interest on $30,000 cost of lighting equipment, $4.64; for 10 per cent depreciation on transformers and lamps, $3.50; total cost, $71.31. A fair selling price to cover profit and a margin in case of accidents, strikes, etc., would be about $85.

It will be particularly noted that a large part of the cost of operating a lamp is not in the actual production of the electricity, but in insurance, taxes, interest on the investment and maintenance and care of the lamps itself. The item of depreciation is very heavy. The advance in the art has been rapid and a change to a new system has hardly been made before a better one or one said to be better is offered. Some companies have in the term of their existence changed their equipment four or five times. Great things are now promised from the magnetite lamp, but whatever this lamp may do for us its installation will mean the scrapping and charging to depreciation of thousands of dollars worth of still useful apparatus, and it will be but a short term before this lamp, too, will follow the others to the scrap pile. This is the rock upon which many companies and more municipal ownership propositions have been wrecked. They failed to provide for depreciation and soon found themselves with an antiquated plant on their hands and no means of providing another.

With the systems in use in many towns each arc lamp requires the generation of one horse-power, by the engines or water wheels at the station. At Niagara Falls with practically unlimited water power, the price of a horse-power is $22.50 per year to large users. It is not possible for any company to distribute over a considerable area in one-horse-power lots even under the exceptional conditions at Niagara Falls, for less than double this figure, as cost. Under other conditions the cost may well be three to four times $22.50. It is recognized all over the country that a horse-power for the ordinary mill operating year of 3,000 hours costs from $40 to $60 generated in the building.

It is evident from an examination of these figures that the prices made for arc lighting in the cities mentioned at the beginning of this paper are very much below cost and that companies furnishing such lighting are paying to the city from $20 to $40 per lamp per annum as an indirect tax. It would appear that the officers of these cities, instead of collecting their taxes for lighting from *all* the people in the city who are benefited by it, have forced through threats of municipal competition or through threats of other ruinous competition, the companies in question to tax their electric light customers for the city lighting, for if the company is to live the loss made by the company on this city lighting must come out of the companies' customers. The law permits all public service corporations, as it should, to earn a fair return upon their investment, and the State has appointed a commission to see that only a fair return is earned. It is evident that if the customers of the gas and electric companies are to be taxed through the company for the cost of city lighting they must wait a longer period, or forever for a reduction in the price of their gas and electricity.

Costly Electroliers.

A good deal has been said about the extravagance displayed in equipping the new State capitol of Pennsylvania at Harrisburg. The charges appear to be well founded. Mr. T. E. Harry, who has made a study of the subject, says in *Harper's Weekly*: "The ordinary meaning of the word 'furniture' was lost early in the process of capitol building. Floors, wainscoting, mantels, lighting systems, telephone systems, etc., were put in and paid for as 'furniture.' The electroliers, the most important item of 'furniture,' cost more than $2,000,000. One can find no other building in the world lighted at such great expense. The citizens of the Commonwealth are dazed by the spectacle of a $4,000,000 capitol which requires $2,000,000 worth of electroliers. And their amazement is heightened by the fact that all of these sumptuous bronze electric lamps were paid for by the pound." Installing telephone wires is set down at a cost of $17,666, and there is a charge of $59,408 for thermostatic valves and thermostats. The "complete lighting system" is said to have cost $71,000, but the details are by no means clear.

Railway Signal Specifications for Rubber Insulated Wire.

At the meeting last month in Washington of the Railway Signal Association, a committee of which Mr. Azel Ames, Jr., is chairman submitted the following specifications for rubber-insulated signal wire for 600 volts or less. In the introduction to its report the committee stated that representatives of the Rubber-Covered Wire Manufacturers' Association were present at a meeting at which the subject matter of the report was discussed, and that there was not an exact agreement upon all of the points.

Conductors.—Conductors must be of soft-drawn, annealed copper wire having a conductivity of not less than ninety-eight (98) per cent of that of pure copper. Each wire forming a conductor must be continuous without splice throughout its length, must be uniform in cross-section, free from flaws, scales and other imperfections and provided with a heavy uniform coating of tin.

Rubber Insulation.—The vulcanized rubber compound shall contain not less than thirty (30) per cent nor more than thirty-three (33) per cent by weight of fine dry Para rubber, which has not previously been used in rubber compound. The gum itself shall not contain more than three and one-half (3½) per cent of resinous extract. The remaining seventy (70) per cent of the compound shall consist of mineral matter only. The insulation must be tough, elastic, adhering strongly to the wire, must be homogeneous in character and placed concentrically about the conductor.

Taping and Braiding.—(*a*) The rubber insulation must be protected with a layer of cotton tape thoroughly filled with a rubber insulating compound, lapped one-half its width and so worked on as to insure a smooth surface.

(*b*) The outer braid must consist of one layer of closely woven cotton braiding one thirty-second (1/32) of an inch thick, saturated with a black insulating weather-proof compound which shall be neither injuriously affected by nor have injurious effect upon the braid at a temperature of 200° F.

Tests.—The manufacturer must provide at his factory all apparatus and other facilities needed for making the required physical and electrical tests and must provide the manufacturer's representative with all facilities for assuring himself that the thirty (30) per cent of rubber as above specified is actually put into the compound. The inspector shall not be privileged to ascertain what mineral ingredients are used in making up the remaining seventy (70) per cent of the compound. The manufacturer shall give free access to the place of manufacture and opportunity to test at all necessary times. Tests will also be made upon the finished product after delivery, and the wire will be rejected if it fails to meet the requirements of the specifications. The manufacturer must pay freight charges for return of all wire that may be rejected by the railroad company.

Physical Test of Copper Conductors.—Each solid conductor must stand an elongation of twenty-five (25) per cent of its length in ten (10) in. before breaking. In torsion it must stand before breaking thirty (30) twists in six (6) in. It must be capable of being wrapped six (6) times about its diameter and unwound without showing signs of breakage after this process has been gone through twice. The tension and torsion tests will be made on separate pieces of wire.

Conductivity Test of Copper.—The conductivity of the copper shall be determined by measuring the resistance of a length of the wire and comparing with Matthiessen's standard of copper resistance.

Tests of Tinning.—Samples of the wire shall be thoroughly cleaned with alcohol and immersed in hydrochloric acid of sp.g. 1.088 for one minute. They shall then be rinsed in clear water and immersed in a sodium sulphide solution of sp.g. 1.142 for thirty-two (32) seconds and again washed. This operation must be gone through with four times before the wire becomes clearly blackened.

Tests of Braiding.—Six-inch sample of wire with carefully paraffined ends shall be submerged in fresh water of a temperature of 70° F. for a period of twenty-four hours. The difference in weight of the sample before and after submersion must not be

more than ten (10) per cent of the weight of the sample before submersion less the weight of the copper and vulcanized rubber.

Physical Tests of Rubber Insulation.—A sample of the vulcanized rubber insulation not less than four inches in length shall have marks placed upon it two inches apart. The sample shall be stretched until the marks are six inches apart and then at once released. One minute after such release the marks shall not be over two and three-eighths (2⅜) in. apart. The sample shall then be stretched until the marks are (9) in. apart before breaking and must have a tensile strength of not less than eight hundred (800) lb. per sq. in.

Chemical Tests of Rubber Insulation.—The vulcanized rubber compound shall contain not more than six (6) per cent by weight of acetone extract and not more than seven-tenths (7/10) of one per cent of free sulphur.

Electrical Tests of Rubber Insulation.—The circular mils cross-section, the thickness of the rubber insulation (measured at the thinnest point), the minimum insulation resistance in megohms per mile and the dielectric strength for the various sizes of wire shall conform to the following table:

Size B. & S. gage.	Area in Circular Mills.	Thickness of Insulation.	Insulation resistance Megohms per mile.	Test voltage Alternating Current.
0	105,592	1/8-in. wall	1200	10,000
1	83,694	1/8 "	1300	10,000
2	66,373	1/8 "	1400	12,000
4	41,742	3/32 "	1300	9,000
6	26,250	3/32 "	1500	9,000
8	16,509	3/32 "	1700	9,000
9	13,090	5/64 "	1700	7,000
10	10,380	5/64 "	1800	7,000
12	6,530	5/64 "	2000	7,000
14	4,107	5/64 "	2100	7,000
16	2,583	1/16 "	1900	4,000
18	1,624	1/16 "	2000	4,000

The test for insulation resistance must be made upon all wire after at least forty-eight (48) hours submersion in water and while still immersed results being corrected to a water temperature of sixty degrees (60) F. Tests must be made before the application of tape, braid or other covering with a well-insulated battery and galvanometer, with not less than one hundred and fifty (150) volts and readings must be taken after one minute electrification. The test voltage must be applied to the completed length of wire before the insulation test for a period of five (5) minutes, using alternating current from a generator and transformer of ample capacity.

New York Lighting Investments.

At the recent annual meeting of the Empire State Gas & Electric Association it was stated by President Cole that there were 120 gas and electric light companies in the State. Their aggregate investment he put at $375,000,000. In the course of his admirable presidential address he said: "In regard to values of lighting, I think this association should appoint a strong working committee to bring out publicly the true costs and values of lighting. Misrepresentation can only be corrected by publicity of facts. Our companies have generally allowed the public utterances of theorists, demagogues and ignorant or prejudiced persons to go forth unchallenged until we can only hope to get in touch with the spirit of the time by honest and open representation. The companies themselves through this association should take the aggressive. A true representation of conditions made at any time is bound to carry weight. A campaign of education should be wrought out and the public enlightened.

"Just what is to be the outcome of the present conditions it is impossible to forecast, but there can be no question of the interest of the people in the operation of public utilities and of the further fact that there is an ever-increasing interest in all municipal problems. Another evidence of the desire for knowledge of municipal affairs is offered not only in our institutions of higher learning, but in our high, and elementary schools. Ten years ago practically no instruction in these subjects was given, now at least twenty colleges and universities offer more or less elaborate courses, and the subject is treated more or less fully in as many more. Instruction in civics is becoming a lively question among educators, and the interest manifested in debates upon municipal problems in our schools may be taken as a fair index of the interest in the subject.

"I have omitted, up to this point, making any reference to the growth in numbers and influence of the organizations wholly or in part interested in the consideration of municipal questions. Now, more than ever, this subject is receiving consideration at the hands of chambers of commerce, boards of trade and other similar bodies, as well as from a rapidly lengthening list of municipal leagues, good government and city clubs and civic associations. It seems to be clearly defined that the work for this association is to develop the general public interest along wholesome and encouraging lines so that they will come to learn that the interest of the public server and the served are mutual."

Co-operative Electrical Development Association.

Mr. Arthur Williams, president of the National Electric Light Association, organized a few weeks ago a committee of five central station managers, to co-operate in the developing and execution of the plans of the Co-operative Electrical Development Association. This committee, which consisted of three members last year, has been enlarged this year to a committee of five, consisting of the following representative men: Mr. W. W. Freeman, Brooklyn Edison Company, chairman; Mr. John W. Gilchrist, Chicago Edison Company; Mr. R. S. Hale, Boston Edison Company; Mr. J. E. Montague, Buffalo & Niagara Falls Electric Light & Power Company; Mr. F. M. Tait, Dayton Lighting Company. Mr. Paul Spencer, the previous chairman, rendered excellent service in the development of the plans last year, but special attention required on another committee necessitated his withdrawal.

Mr. Freeman called a meeting of the above committee in Brooklyn on October 30, and the entire day was given over to a careful and detailed consideration of the proposed constitution and by-laws, as well as the detailed commercial plans for 1907, submitted by Mr. J. Robert Crouse. President Williams was also in attendance.

This conference, which will be followed rapidly by similar conferences with the co-operating committees of the manufacturers, jobbers, contractors and representatives of the technical press and advertising agencies, is all preliminary to a meeting of the joint committee of all branches of the trade, to be held in New York within a few weeks, at which it is expected to formally complete and finally agree upon a scheme of organization and the commercial plans for work in 1907.

After a very busy day, Chairman Freeman and his associates, Mr. F. F. Wells, Joseph F. Becker, Jr., P. R. Atkinson, M. S. Seelman, gave a dinner for the confreres at Delmonico's, followed by a theatre party. The day's activities concluded very pleasantly with a luncheon and smoker given by President Williams. It was the unanimous expression that the day had been crowded as full of "co-operation," both business and social, as was possible, and this meeting marks a long step in the advance of this co-operative campaign.

Meeting of Indiana Telephone Men.

A meeting of the Ninth District of the Indiana Independent Telephone Association was held at the Grand Hotel in Vincennes, November 1. Mr. Dilly, of Huntingburg, read a paper on the value of rural telephones. After citing the manifold uses and benefits which the telephone brings to the rural people, he concluded by advocating standard construction and insisted that the time was coming when the telephone companies of this country would be so numerous that uniform instruments and standard construction would be necessary. He also urged the managers of rural telephone companies to secure a fair rental from their investments and provide a sinking fund for future repairs and extensions.

Mr. Charles McGregor, of Mt. Vernon, reviewed the progress being made by the independent telephone companies in the

Ninth District. He said that there had been an increase of 15 per cent during the past year, and that new subscribers were being secured as rapidly as the lines could be extended for their accommodation.

Statements made by a number of delegates show that the independent telephone companies of the State are in excellent condition, and that the managers are determined to stand aloof from any alliance with the Bell Telephone Company. President Lindermuth and Secretary Norton, of the State Association, were present, and made encouraging talks before the convention. After adjournment the delegates were entertained at luncheon at the Grand Hotel, as the guests of the local independent telephone system.

Meeting of the New York Electrical Society.

The meeting of the New York Electrical Society on October 31 at which Prof. V. Karapetoff, of Cornell University, was the speaker, proved to be one of exceptional interest, if the attitude of the audience towards the speaker can be taken as a criterion. Prof. Karapetoff, in his talk on "The Human Side of the Engineering Profession," treated of the principal requirements for an efficient engineer. Detailed advice was given as to the methods for acquiring the necessary qualifications by study, observation and training of the character; and the limitations usually met with were discussed in a helpful and suggestive manner. It was pointed out that the principal factors affecting an engineer's professional success are knowledge, personality and the views of life held. Although the subject chosen is a difficult one, and there are few speakers who can hold the attention of an audience during an hour of serious talk on such a subject, seldom indeed has an audience been more uniformly attentive and enthusiastic than the one which greeted Prof. Karapetoff on this occasion.

Installation and Maintenance of Storage Batteries.

At the annual meeting in October in Washington of the Railway Signal Association, a committee, of which Mr. I. S. Raymond was chairman, submitted a report on the installation and maintenance of storage batteries for railway signal service, from which we quote the following relating to the maintenance of the batteries and the tests of electrolyte recommended:

Storage cells used in signal work should be examined once a week, by making voltage and sp.g. test, and inspecting for short-circuits. If the electrolyte is kept free from impurities and the plates free from short-circuits, the cells will hold up under very severe conditions. The sp.g. of the electrolyte must never be adjusted until the cause of the disarrangement is found and removed. A pilot cell is not advisable in small sets such as used in signaling. An overcharge once a month will keep the cells in good working state under ordinary conditions.

Pour the electrolyte into a cell in which the regular battery plates are immersed. If gassing takes place for sometime on open circuit, the presence of platinum is indicated and a test by a skilled chemist should be made, as the smallest trace will discharge the cell.

To half a test tube of electrolyte add a few drops of chemically-pure nitric acid (HNO_3), boil and when cool to half of this add a few drops of potassium-sulphocyanide (KCNS); a deep red color will show the presence of iron. To the other half add ammonia in excess, set aside to cool and a brown precipitation shows iron present in dangerous quantity.

Dilute electrolyte with five or six volumes of water and add a few drops of nitrate of silver ($AgNO_3$); a cloudy white precipitate turning blue in sunlight indicates chlorine.

Put 25 cu. cm. electrolyte in a test tube and add 10 grams of strong ferrous sulphate solution; carefully pour down the side of the test tube 10 c.c. of chemically-pure concentrated sulphuric acid. If nitric acid be present it will be indicated by a stratum of brown color, which will form between the solution and the concentrated acid. The depth of color will indicate the relative proportion of nitric acid present.

To a sample of electrolyte add an excess of ammonia hydrate; a rich blue color indicates the presence of copper. Or to a sample of electrolyte add potassium hydrate; if a blue precipitate is found which turns black upon boiling it is an indication of copper.

The presence of mercury in the electrolyte is indicated by a black precipitate when lime water is added, or by an olive green precipitate when potassium iodide is added.

Mexican Law on Concessions.

Our Mexico City correspondent states that there are some very important changes in the law touching concessions. Under the present law the tax on water power is simply nominal, whereas under the new law the tax will be as follows: (1) For every leaf of the concession, $5; (2) for every horse-power, to be determined in the manner provided by the law itself, $2 if the concession is for thirty years or more; if for a shorter period the rate will be $1 per horse-power. With regard to irrigation concessions, the rate will also be five dollars per leaf, and in addition, if the concessions be for thirty years or more, the tax will be at the rate of $5 for every cubic meter per second, or if less than 30 years, $2.50 per cubic meter per second.

Regarding railway concessions, the change is quite important; the same charge remaining of $5 per leaf, and, in addition, $10 for every kilometer which it is proposed to construct. On mortgages the charge is reduced from 70 cents, as at present, to 50 cents per $100 borrowed.

Another notable reduction is effected with regard to powers of attorney, entered into before a notary public. At present the stamps required, when the amount involved is stated, are at the rate of 2 cents for every $20 or 10 cents per $100. Under the new law the ad valorem duty will be done away with altogether and a uniform stamp tax will be imposed irrespective of the amount involved, as follows: (1) If there is only one principal and attorney, the tax will be $2 per leaf; (2) if three persons intervene, the stamp must be $4 per leaf; (3) if four persons, the stamp rate is for $6 per leaf, and (4) if five persons, the stamp must be at the rate of $8 per leaf.

With respect to contracts for the loan of money the rate is reduced from 70 cents per $100, as at present, to 50 cents.

Locating The Magnetic Pole.

Capt. Ronald Amundsen, who opened up the Northwest Passage, and has been locating the magnetic north pole, is in New York City. He states that the idea of relocating the magnetic north pole, which had been established by the English Admiral Sir James Clark Ross in 1831, came to him after reading the works of Prof. George von Neumayer, Germany's greatest authority on the subject. "The primary undertaking was to find the place where the needle stands perpendicular," Capt. Amundsen said. "After conferring with Prof. von Neumayer, I decided to make an attempt to navigate that northwest passage which has barred mariners for centuries. My ship, the *Gjoa*, left Christiania in June, 1903. We went as straight as we could to the vicinity of the magnetic north pole, and there Lieut. Hansen and I began observations which were pursued for nearly two years. It may take us years more to work out the notes which we made on these observations, but we have established the exact location of the magnetic north pole. When we had satisfied ourselves of this the *Gjoa* continued her trip through the Northwest Passage, and on August 30 of this year we sailed through Bering Straights with the Norwegian flag at our masthead."

On the way to this city from San Francisco, where the *Gjoa* now lies, Capt. Amundsen, Lieut. Hansen and the crew of the vessel were fêted by their countrymen at many points. Capt. Amundsen has received the Grand Cross of the Olaf Order from King Haakon, of Norway. The captain has been notified of this award by cable. A prize on deposit with the English Government for the first man to effect the Northwest Passage will undoubtedly be awarded to Amundsen also, besides a substantial grant from his own government. Great preparations for his welcome

home, in which Fritjof Nansen, the explorer, is taking an active part, are in progress in Norway. Capt. Amundsen will lecture before the Norwegian Geographical Society and later in London before the London Royal Geographical Society.

CURRENT NEWS AND NOTES.

CHICAGO A. I. E. E.—Mr. Bion J. Arnold addressed a meeting of the Chicago section of the American Institute of Electrical Engineers on November 2, giving an illustrated account of the New York Central terminal electrification.

A WIRELESS TELEPHONE.—A dispatch to the London *Morning Leader* from Copenhagen says that a lieutenant of the Swedish army after four years experimenting has invented a complete wireless telephone. Swedish newspapers state that there will be a public demonstration of the invention in December.

BOILER EXPLOSIONS.—Statistics compiled by D. H. McAbee, chief of the Indiana Department of Factory Inspection, go to show, it is declared, the need of further legislation in Indiana in regard to the laws regulating boiler inspection. According to the chief's figures, during the last six years there have been 64 explosions, resulting in nearly fifty deaths, and 105 injuries.

TESTING ELECTRICAL MACHINERY.—Mr. L. T. Rainey, of the power and mining department of the General Electric Company, of Schenectady, N. Y., will deliver a series of lectures before the Electrical Department of the Technical Institute of Indianapolis this week. Mr. Rainey's subject will be "Factory Testing of Electrical Machinery," and his lectures will be illustrated by lantern views. The local electricians, as well as a large number of students, are greatly interested in the course.

PARCELS BY TROLLEY.—According to *Concerning Municipal Ownership*, the first year's working of the Manchester, England, tramways parcels service has resulted in a deficit of nearly $30,000, according to the report of the manager. He also admits that the service cannot be made to pay unless there is a large increase in capital outlay, and that the employes have much longer hours than can be justified. Such systems in the hands of American trolley companies have proved successful.

CHICAGO ELECTRICAL SHOW.—Mr. Homer E. Niesz, managing director of Chicago's second annual electrical show, under the auspices of the Electrical Trades Exposition Company, reports that the space already sold for the show at the Coliseum January 14 to 26, 1907, is far in excess of that disposed of at the 1906 show. Many of the larger concerns have taken double their space of last year. Mr. Niesz has established offices at 1006 Monadnock Block, which will be continued until the close of the show.

STOPPED BY MILLER MOTHS.—Note was made in these columns recently of stoppage of a plant by miller moths. Mr. F. H. Vincent, of the Northwestern Gas & Electric Company, of Pendleton, Ore., writes us as follows in regard to the occurrence: "The story was essentially true. It was a warm summer night and all windows were up. The white millers collected on the main driving belt, causing it to slip on the pulley on the countershaft. It was some little time before we could locate the trouble. When we did, of course, we wiped off the belt and shut down the windows. It was some time, however, before we got the belt in good condition."

AMERICAN RAILROADS.—There were 217,341 miles of completed railroads in the United States at the end of 1905, according to the figures compiled by *Poor's Manual* for 1906, of which the advance pages have just been issued. This is a net increase of railroad mileage in 1905 of 4,716 miles. The capital stock represented amounted to $6,741,956,825, according to the same authority, and the bonded debt to $7,425,261,901. The total liabilities of the lines aggregate $16,292,880,823, against $15,495,504,651 in 1904. The cost of the roads and their equipment is figured at $12,143,997,551, against $11,664,191,134 in the previous year. The total traffic revenue was $2,112,197,770, with operating expenses of $1,368,549,574. The passengers numbered 745,446,641, and they were carried 23,906,420,668 miles.

BUSINESS METHODS.—Mr. George Williams, editor of the new business methods department of the American Gas Institute, has just issued an interesting and handsome volume as its report, being part of the recent Chicago convention proceedings. It is actually the production of several hundred keen-witted men engaged in the promotion of gas sales throughout the United States, and deals with their actual work, including newspaper advertisements, mail and miscellaneous advertising, salesrooms, demonstrations and other features of publicity. The book includes a number of original discussions of the subject and its 300 pages are profusely illustrated with examples of good advertising. There are eight parts, and each is replete with excellent matter, as valuable to the electric lighting manager as to his gas rival and colleague.

PROJECT FOR MONTEVIDEO.—United States Consul John W. O'Hara reports from Montevideo that "a law has been enacted by the Congress of Uruguay providing for the expenditure of $1,200,000 Uruguayan gold, equal to $1,240,800 American gold, for the improvement and extension of the electric lighting system of the city of Montevideo and suburban towns. For the purpose of securing the necessary funds to pay for these improvements, it is provided that the city shall issue debenture bonds bearing annual interest at the rate of 5 per cent per annum, and 4 per cent annual amortization. American manufacturers interested in the manufacture of electric lighting machinery and apparatus may obtain full information by addressing J. A. Capurro, Ministro de Fomento, Montevideo. Although the plans have not yet been published, it is evidently the purpose not only to renew and extend the present public system, but also to add a general commercial system. I am also informed that agents of the Government have been sent to Europe to investigate electrical plants and machinery."

WOFUL WASTE.—So far as known, only one really fireproof building exists in this country. There are in the United States, according to *Collier's Weekly*, 11,500,000 buildings valued at $14,500,000,000. In 1905, which was a normal year, $500,000,000 was spent for new buildings, and $200,000,000 worth of old buildings were burned up. Over $300,000,000 was paid for fighting fires and $195,000,000 in fire insurance premiums, of which some $95,000,000 was paid back by the companies for losses. Hence it cost more to burn part of the old buildings and protect the rest from burning than it did to put up all of the new ones, and that was in a normal year. This year is not normal, as San Francisco has raised the fire losses to $500,000,000, to say nothing of what may be added. According to *Collier's*, the $500,000,000 worth of buildings which have burned down would have cost only $50,000,000 more to have been made absolutely fireproof, and for the extra $50,000,000 the $500,000,000 could have been saved. Electrical engineers can do their share to prevent part of this awful annual waste.

DEVELOPMENT IN PARAGUAY.—United States Consul J. N. Ruffin writes from Asuncion that on October 1, at the office of the Paraguayan Minister of Interior, bids were to be opened for the construction of the works of public health, electric light and power, and electric tram service for the city of Asuncion in accordance with the law recently enacted by Congress, translated extracts of the important parts of which are on file for inspection at the Bureau of Manufactures. Mr. Ruffin adds that the time between the enactment of this law and the call for bids was too short to expect any offers from the United States, but the point of interest to the American manufacturer and exporter is to send forward catalogues with full information on accessories necessary for these different enterprises. The Government guarantees interest at 6 per cent on the capital invested in the water works, providing that it does not exceed $1,200,000 gold. The electric light and power concession requires the production of 1,500 hp and the erection of 12½ miles of lines within two and one-half years, while the trolley franchise stipulates that 12½ miles be ready for service in two and one-half years.

AWARDS AT MILAN.—The Count of Turin on November 13 distributed the awards of the International Exposition at Milan, Italy. American firms were given 82 awards, including 18 grand prizes, 17 diplomas of honor and 28 gold and 15 silver medals.

PUBLIC POLICY COMMITTEE.—President Walton Clark, of the American Gas Institute, has appointed as the public policy committee of that body Messrs. E. G. Cowdrey, of St. Louis; Irving Butterworth, of Detroit, and W. H. Gardiner, of New York City. The last-named is a member and secretary of the kindred committee in the National Electric Light Association.

GOOSE AND GANDER.—The Western Union Telegraph Company is suing the Indiana State Board of Tax Commissioners for alleged unfair discrimination in fixing tax valuations. The company alleges that the tax board has assessed its lines at $69 a mile, while the Postal Telegraph Company, whose lines have been more recently erected of heavy copper wire, is assessed at only $40 per mile.

THE ASHTABULA PLANT.—After a painful experience the city council of Ashtabula, Ohio, has passed an ordinance directing that the municipal electric light plant be sold to the highest bidder. The plant began operations in 1892, the construction cost exceeding $88,000, of which $50,000 is regarded as a total loss owing to the plant having been allowed to run down. Although operated on moonlight schedule the average cost of arc lighting has been in excess of $100 per lamp per year.

TROLLEY AND LAND VALUES.—The effect of trolley lines on land values is beginning to be apparent, even in portions of the country where lands have hitherto been comparatively cheap. It is noted by the *Wall Street Journal* that a line of ten miles between Anderson and Belton, S. C., has greatly increased since it became known that a trolley line was going to be constructed. Farms along the line within one mile of the right of way are reported to have advanced in value by from 33⅓ to 50 per cent, while farms over a mile from the right of way have increased by from 15 to 30 per cent. The percentages represent actual land sales, and not asking prices.

A NEW FISH STORY.—It is stated from Massachusetts that the wireless telephone has successfully entered into the deep sea fishing industry. For the last week experiments have been conducted by the wireless telegraph station at Brant Rock, which is equipped with a wireless telephone, with a small vessel stationed in the fleet of the South Shore fishermen, twelve miles out in Massachusetts Bay. Recently, it is asserted, the fishermen wished to learn the prices ruling in the Boston market. The operator on the wireless fitted boat called up Brant Rock and telephoned the fishermen's request. The land operator asked Boston by wire and the answer was forwarded back to the fishermen. This is a rather fishy fish story.

THE LONDON ELECTIONS.—Last week the triennial elections of the London Borough Councils resulted in an overwhelming victory for the "Municipal Reformers," who in some of the boroughs absolutely wiped out the Progressives. The victors were formerly known as Moderates. After several years of a Progressive municipal ownership régime, during which the taxes were increased to abnormal figures in consequence of huge expenditures, including palatial workhouses, Turkish baths for workmen, who did not use them, and club houses and other similar municipal luxuries, the Borough Councils are once again great strongholds of conservatism. Complete returns show that the Reformers won 1,011 seats, the remaining 351 being divided between the Progressives, Laborites and Independents. The "revolt of the taxpayer" against municipal ownership is most significant, but was expected.

NIAGARA POWER.—Briefs have been submitted at Washington to the War Department for the power and transmission companies affected by the order of the department limiting the amount of water which they might take from the Niagara River for power purposes, as well as the horse-power that might be conveyed into the United States from the Canadian side of the river. These briefs form the basis of a hearing which was to have taken place before Secretary Taft, in Washington on November 12 next, but owing to the Secretary's absence it is expected that the date will be postponed to the 19th inst. Elaborate briefs were submitted by the Niagara, Lockport & Ontario Power Company, and jointly by that company and the Ontario Power Company, asking permission for the transmission of 90,000 hp to meet existing contracts and for a revocable permit for an additional 90,000 hp to meet future needs.

MADAME CURIE.—A special dispatch from Paris of November 1 says: "Mme. Curie, who opens her lectures at the Sorbonne to-morrow, will be the first woman to occupy a chair in that ancient university. The 'feminists' of Paris are planning a rousing demonstration to celebrate the event, though Madame herself refuses to have any connection with their general programme. She has resolutely declined to be interviewed on any subject, and takes the greatest precaution to avoid publicity in every way. She enters her laboratory by a secret door, remote from the main entrance, and appears to dread surveillance of her studies. It has astounded the confreres of the feminine professor to see her sweep out her own laboratory after an experiment, for Madame is suspicious even of the servants. Her lectures will be on radioactivity, expounding the theory that matter is not reducible to atoms, but to forms of electricity. In other words, matter, as it is understood, is non-existent; only force exists."

TAXING RADIUM.—A new problem presents itself under the tariff. Whether radium is a chemical salt or a salt of uranium is the puzzle that the New York customs officials are trying to solve. In the last two years several small consignments of radium have been received at New York. The question of classification has been brought up by importations made by a firm of chemists, of New York. The Dingley tariff law makes no specific provision for radium. After a consultation it was decided that radium is a chemical salt, which is taxed at the rate of 25 per cent ad valorem. The counsel for the importers stated last week that the classification of the collector of the port would be appealed to the Board of Appraisers and the courts. An application has been made to the board to review the decision. Testimony has been laid before the general appraiser to the effect that radium should be placed on the free list under the provision in the law for salts of radium. Prof. Halleck, of Columbia University, and other authorities on the composition of radium have submitted testimony that radium is a salt and a derivitative of uranium.

SUMMONED BY WIRELESS.—In a political speech last week against Mr. William Randolph Hearst and relative to the difficulty of reaching that distinguished gentleman in any litigation, ex-Mayor Low, of New York, told the following story: "During my own term as Mayor it became necessary for the Corporation Counsel to serve Mr. Hearst with a summons in some suit. He tried for weeks to do it without success; finally he heard that Mr. Hearst had sailed for Europe, and then he served him by wireless telegraphy. Somebody in the Corporation Counsel's office was sagacious enough to see that he could not get on the ship, so they arranged with the telegraph company that the operator on that ship should give him the notice personally, so as to be able to make an affidavit that it had been served. This official carried out his instructions literally, with the result that Mr. Hearst was waked up at 2 o'clock in the morning to receive the notice that compelled him to pay attention to the laws of the State of New York in that particular case. I have often wished that I might have heard his observations on that occasion. I looked at the *Journal* for several days after the event had taken place, expecting in the innocence of my heart that I should see headlines as big as that (illustrating) to the effect that Mr. Hearst had consented to be served in midocean, but I am sorry to say his observations, however interesting, are not upon record."

PACIFIC COAST DEVELOPMENT.—Reports from Seattle credit the Westinghouse electrical interests with the intention of creating a Pacific Coast plant there, and state that the deeds have passed for several tide land lots, ample for the erection of large factories.

MOTOR WAGON CONTEST.—Although a number of entries for the motor wagon contest of the Automobile Club of America had been received, a general canvas of the makers of commercial vehicles developed the fact that the proximity of the two New York shows, followed by those of Chicago and Boston, rendered it difficult for them to prepare for the contest scheduled to be held from November 7 to 10, inclusive. The governors of the club, therefore, at their meeting on October 31, decided to postpone the contest until spring.

NIAGARA POWER.—Secretary Taft is again to take up on November 12 the question of the amount of electrical power to be obtained from Niagara. At the present time, the power companies which bring electricity from the Canadian side of the river are doing so under temporary permits issued by the secretary shortly after the hearing held in Niagara Falls. The Burton law permits the transmission of 160,000 electrical horse-power from Canada to the United States so long as the amount of electrical power developed on the Canadian side does not exceed 350,000 horsepower. When the amount generated on the Canadian side exceeds this amount, the law provides for a reduction of the amount to be transmitted to the United States.

CEMENT TELEGRAPH POLES.—A correspondent writes us that several miles of telegraph and telephone poles, made of cement, have been planted in the vicinity of Maples, Ind. They are made by H. W. Tapp, and are from 25 to 35 ft. long, 9 in. square at the base for a distance of 17 ft., when they taper at the top to 6 in. They have niches for the spurs of the linemen, who climb them, and holes near the top for the reception of iron rods, which hold the cross arms. These poles are attracting considerable attention on the part of telephone and telegraph men, and if they prove successful, though somewhat more costly than wooden poles in the beginning, it is claimed they will be more economical in the long run by reason of their lasting qualities.

STATUE OF MACKAY.—A fine bronze statue of Mr. John W. Mackay, the famous miner and organizer of telegraph and cable systems, has been furnished by Mr. G. Borglum, the sculptor, and has now been sent from his studio in New York to Reno, Nev., where it is being placed in front of the new School of Mines of the State University of Nevada. This school is the gift of the widow and son of Mr. Mackay, who now make this felicitous addition to their gift. The statue is a most spirited representation of Mr. Mackay in simple miner's dress, pick in one hand and in the other a fragment of ore. Altogether the figure is not only a splendid piece of portraiture, but might well be accepted to stand as the representative miner of America.

THE PORTLAND BULLETIN.—One of the best bulletins in the central station field is that of the Portland (Ore.) General Electric Company, edited by Mr. B. I. Dasent, which has just completed its first year. The experience of the company has been that the issuance of the bulletin monthly is most profitable. Mr. Dasent says: "We have secured direct results from it, showing that customers have been educated in the use of electricity for varied purposes other than as an illuminant. It is conclusive that through the bulletin a better feeling has been created in the minds of customers toward the company, by its attitude of taking them into its confidence. It is undisputed that people are distrustful of a thing, a person or a corporation of which they know little; and it is this latent feeling that the bulletin wishes to dispel."

EXPOSITION OF SAFETY DEVICES.—The exposition of safety devices to be made by the American Institute of Social Service January 28 to February 9, 1907, is well advanced, and a large number of interesting exhibits is already promised from Europe. Prominent Americans also are lending their co-operation as honorary vice-presidents: Grover Cleveland, first vice-president; Hon. Frank W. Higgins, Governor of New York; Hon. Curtis Guild, Jr., Governor of Massachusetts; Hon. E. C. Stokes, Governor of New Jersey; Hon. Henry Roberts, Governor of Connecticut; Hon. C. P. Neill, U. S. Department of Labor, Washington, D. C.; Hon. T. P. Sherman, Labor Commissioner of the State of New York; H. C. Bumpus, Director American Museum of Natural History. Requests for information regarding space should be made to Dr. William H. Tolman, Director, 287 Fourth Avenue, New York.

SERVING CORRECT TIME.—Mr. Archie M. Fitch, of Philadelphia, writes us: "In the Electrical World, Mr. James Asher, of Buffalo, has proposed a scheme for giving the correct time to inhabitants of cities and surroundings by means of the electric lights. This is no new scheme, for that idea has been in practice here in Philadelphia for several years. The time is indicated at 9 o'clock in the evening in the following manner: On top of the city hall tower is a ring of arc lights. This tower is 550 ft. high, and surmounts the largest municipal building in the world. These lights may be seen within a radius of twenty or more miles. At three minutes of nine the lights are extinguished, and at precisely 9 o'clock the lights are turned on. We find this time is just as reliable as the dropping of the ball from a pole on top of the Bourse at 12 o'clock."

PLATINUM PRODUCTION.—The annual report of the United States Geological Survey on the production of platinum in 1905 gives the output in this country as 318 ounces, valued at $5,320, as against 200 ounces, valued at $4,160, in 1904. By far the larger supply of this metal comes from abroad. The imports in 1905 were valued at $2,173,263, as against $1,879,155 in 1904, an increase in value of $294,108. The imports in 1905 were: Unmanufactured, 1,598 lb. ($296,883); ingots, bars, sheets and wire, 6,228 lb. ($1,688,224); vases, retorts and other apparatus, vessels and parts thereof for chemical uses, $186,742; manufactures of, not specially provided for, $1,414. The imports in 1903 were valued at $2,055,933, in 1902 at $1,987,980, and in 1901 at $1,695,895. The yield of the Russian platinum deposits, which usually furnish about 90 per cent of the world's supply, has been greatly reduced by the unsettled condition of affairs in that country. Platinum is found in Oregon, Idaho, Colorado, Washington, Montana, Utah, Arizona, Wyoming, Alaska and Porto Rico, and is expected to be the basis of an important mining industry here in the near future.

EUROPEAN ELECTRIC FURNACES.—In a recent lecture at Sheffield, England, Dr. R. S. Hutton, of the Manchester University, stated that 80,000 hp is now employed in the production of aluminum, and a large amount of power is devoted by means of the electric furnace to the production of calcium carbide. The chief field at present open to the electrical furnace in iron and steel metallurgy is in the production of ferro-alloys, and in this connection Dr. Hutton gave interesting figures as to the furnaces in the south of France, where the most important plants are situated. At Grenoble five furnaces of 1,200 hp and four of 2,000 hp are used for the manufacture of ferro-silicon, ferro-chromium, silico-spiegels of varying composition and manganese silicon. The output is between 7,900 and 8,400 tons a year. At the Giraud's Works, in the south of France, there are furnaces of 18,000 hp shortly to be increased to 40,000 hp, and with an output at present of the value of 9,000,000 francs a year. The production is 5,000 tons of ferro-silicon of 50 per cent, 1,000 tons of ferro-silicon of 30 per cent, 2,000 tons of ferro-chromium, 800 to 900 tons of ferro-tungsten, 50 tons of ferro-molybdenum and 5 to 10 tons of ferro-vanadium. It was stated that the most important development of recent years is the application of the electric furnace to the production of ferro-alloys of low carbon content. Dr. Hutton considers that there is considerable promise of the adoption of the electric furnace in the manufacture of tool steels. He mentioned a 450-kw Kjellin induction furnace now at work and said that a large number of these furnaces are now in operation or under construction in Sweden, Switzerland, Spain, Germany, Austria and England. In Germany are furnaces utilizing 725 hp, with a capacity of 24,000 kilos, an actual charge of 15,000 kilos and a daily output of 90,000 to 120,000 kilos.

The Electrical Equipment of the Camden-Atlantic City Railway.

THE Pennsylvania Railroad Company owns two roads connecting Atlantic City with Camden, N. J., both of which were originally operated by means of steam locomotives. During the present year, however, the longer of these routes, which handles a large local traffic, has been electrified because it was estimated that electric traction would prove more economical than steam haulage. The power house, sub-station equipment and the transmission line are laid out with a view of supplying power for the operation of an express service from Camden to Atlantic City, consisting of three-car trains running on a headway of fifteen minutes in each direction at a speed on straight level track of 60 miles per hour, and a local service of two-car trains at half-hour intervals and single cars at ten-minute intervals.

The electrified system extends from Camden via Newfield, to Atlantic City, a distance of 65 miles, and from Newfield to Millville, a distance of 10 miles. In addition to the erection of a power house, the work has called for the building of eight sub-stations, one of which is in the power house, the electrical equipping of approximately 150 miles of single track, the building of 71 miles of duplicate high-tension transmission line, and the building of 68 motor cars.

The power house is situated at Big Timber Creek, just to the north of Westville, N. J., at a point 5.6 miles from the Camden terminal, where there is an abundance of water for boiler feed and condensing purposes. The present normal capacity of the generating station is 6,000 kw, which is obtained from three 2,000-kw, 6,600-volt, 25-cycle, three-phase Curtis turbo-generators. Space is provided, however, for an additional 2,000-kw turbo-generator set with the necessary auxiliaries. The station contains at present two 75-kw, 125-volt Curtis turbo-exciter units, nine 700-kw, 6,600 to 33,000-volt air-blast transformers and three blowers, each having a capacity of 20,000 cu. ft. of air per minute. The area of the power house is 17,069 sq. ft., and the cubic contents amounts to 829,113 cu. ft., thus giving 2.13 sq. ft. and 103.6 cu. ft. per kw, based on 8,000 kw as the ultimate capacity of the present structure.

The boiler house is furnished with 12 Stirling water-tube boilers arranged in pairs forming six batteries. Each boiler is rated at 358 hp and is furnished with a superheater capable of delivering steam at 175 lb. pressure and at a temperature of 125° F. in excess of that of saturated steam. The coal is dumped from the railway cars into a receiving hopper over which rails are laid. The receiving hopper has a slanting bottom to feed the coal by gravity through a valve, which is opened only when the skip is in the correct position for loading. The loaded skip is raised by means of a hoisting engine till it reaches the level of the deflector, when it is automatically tipped into the crushing hopper, the smaller coal passing through the screen and the larger coal being broken in the crusher in transit. From this hopper the coal is fed into the gravity return car by means of valves at the bottom, when it is conveyed by an automatic railway over the coal bunkers into which it is tipped. From these bunkers it is again fed to the coal cars on the tracks on the boiler room floor. The ashes are taken from the boiler house in cars and dumped into the receiving hopper, from which they are raised in a similar manner to the coal. The ashes are conveyed from the ash chute to the ash storage bin, from which they are conveyed by means of a chute to cars on the railway track.

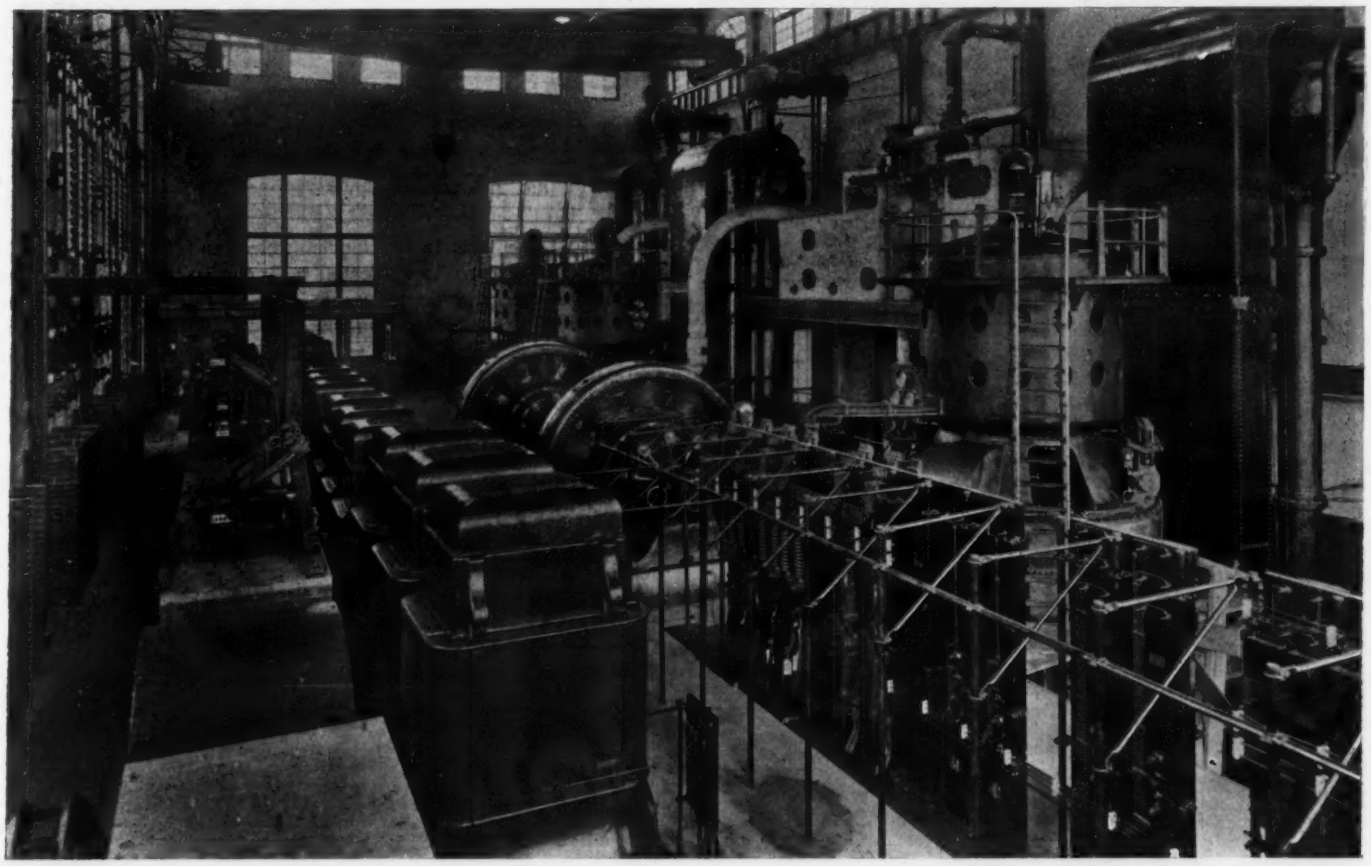


FIG. 1.—VIEW OF INTERIOR OF WESTVILLE POWER STATION.

The 33,000-volt, three-phase current is reduced in pressure and converted to direct current at 650 volts in eight sub-stations distributed along the line as follows:

One is located in the power house at Westville. There are three terminal sub-stations situated respectively at South Camden, Clayville and Atlantic City, and four intermediate sub-stations, one at Glassboro, one at Newfield, one at Mizpah, and one at Reega.

Head of sub-station.	K.W. capacity of rotary converters already installed.	K.W. capacity of additional rotary converters provided for.
South Camden	2-750	1-750
Westville (in power house)	2-750	1-750
Glassboro	2-750	1-750
Newfield	2-750	1-750
Clayville	2-500	1-750
Mizpah	2-500	1-750
Reega	2-750	1-750
Atlantic City	2-750	2-1000

The equipments in the several different sub-stations vary according to the requirements of the portion of the road they supply. The above table shows the number and capacity of rotary converters installed in each sub-station, together with the extra capacity provided for.

The sub-station buildings are of red brick, trimmed with Indiana limestone facings, and the floors are of concrete. Each sub-station is furnished with a hand-operated crane, capable of handling any of the machinery installed.

The rotary converters are all of standard General Electric design, and are capable of running at 50 per cent overload for two hours with a temperature rise not exceeding 35°. The transformers are all supplied with taps giving one-third and two-thirds of the working voltage to enable the converters to be started from the alternating side. This method of starting does not require synchronizing, and should the direct polarity of the machine chance to come in the wrong direction it is readily changed by means of the field reversing switch, which is provided for this

FIG. 2.—TRANSFORMERS, LIGHTNING ARRESTERS, ETC., WESTVILLE POWER HOUSE.

purpose. By this method any of the rotary converters can be started, run up to full speed, and be delivering power to the line within a minute.

Three air-cooled transformers are provided for operation in conjunction with each rotary, and these are located in each case with a view to the further extension of the sub-station; as they are all of standard design it is not necessary to go into details regarding their construction.

The disconnecting switches and lightning arresters in each sub-station are located in a separate room (Fig. 8); the high-tension circuits are of bare copper wires supported on insulators on a pipe framework, and each pole of the oil switches is enclosed in a separate brick compartment. In all cases the instruments and oil switches are of General Electric design.

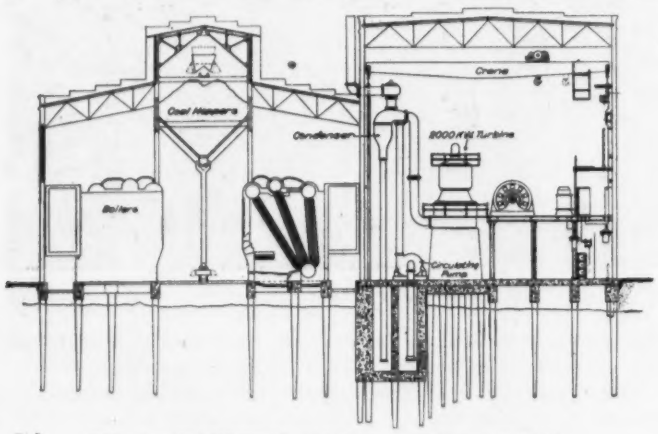


FIG. 3.—TRANSVERSE SECTION OF POWER HOUSE.

For the purpose of illustration, the intermediate sub-stations with two 750-kw rotary converters are selected as being typical. Figs. 5 and 6 are respectively the plan and the transverse section of a typical sub-station.

The 33,000-volt transmission line is in duplicate throughout. It consists of six No. 1 B. & S. hard-drawn solid copper wires mounted on porcelain insulators. The poles are of chestnut, their height being 45 ft., with extra long poles where special conditions require. They are spaced 125 ft. apart, but at street crossings the spacings are reduced to 100 ft. Head guys are used at distances of approximately one-quarter of a mile. There are two cross arms, the top arm being 12 ft. in length, carrying four steep hills, which will cause a growing of the motor current, sulators. The six wires form two inverted equilateral triangles, the insulators on each triangle being 42 in. apart. The wires in each triangle are transposed through one complete spiral between each sub-station.

The cross arms are fastened to the poles by means of bolts and as an additional support they are stiffened with galvanized-iron braces. Locke insulators are used, made in three parts and designed to withstand double the working pressure. Each petticoat was tested separately, the top section to 45,000 volts. In

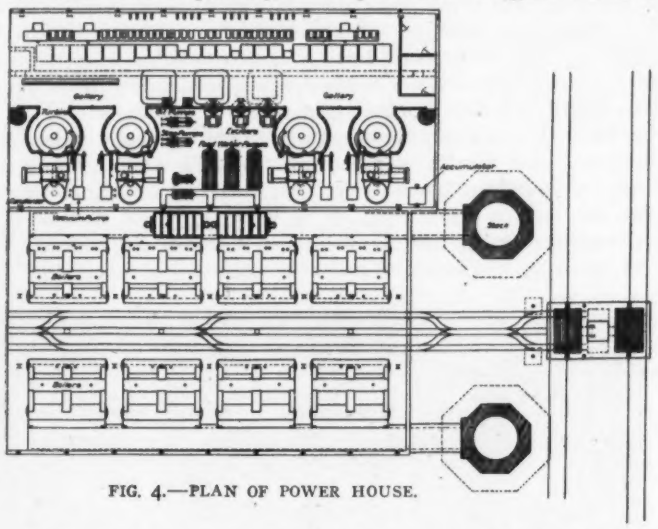


FIG. 4.—PLAN OF POWER HOUSE.

each case these tests lasted four minutes, and following this the assembled insulator was subjected to 85,000 volts for ten minutes, and also a precipitation test was made at 52,500 volts. The insulators are mounted on iron pins.

A unique feature of the transmission line is the means for protection from lightning, which consists of a seven-strand galvanized steel cable 5/16 in. in diameter strung for the entire length of the line on top of the transmission poles, 4 ft. above the nearest active wire, and provided with ground connections at every fifth pole. This form of protection from lightning is believed to be an efficient supplementary adjunct to the arresters.

The rails used for the working conductor are of the Pennsylvania Railroad standard cross-section and composition, weighing 100 lb. per yard, and have an electrical conductivity about equal to that of a copper rod of 1,200,000 cir. mil. This type of third rail was used in order that it might be interchangeable with the track rails.

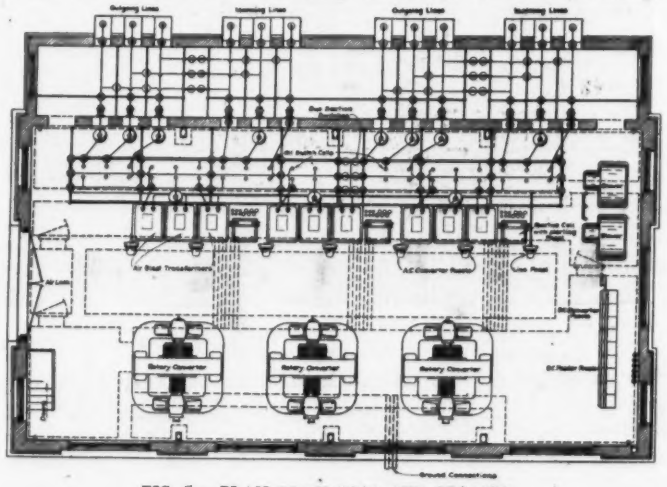


FIG. 5.—PLAN OF TYPICAL SUB-STATION.

The rail insulators are of reconstructed granite, and are held in position by a metal centering cup which is secured to the long ties by means of a lag screw. The insulators are 10 in. long and 5½ in. broad at the base, with an effective depth from the bottom of the rail to the tie of 3½ in. An advantage of this method of securing the position of the insulator is that on the ties being depressed by the passage of a train no tension strain is brought to bear on the insulators. The insulators are spaced about 8 ft. apart. The top of the third rail is 3½ in. above the

top of the track rails, and its gauge 26 in. distant from the gauge line of the adjacent track rail, these dimensions constituting the standard of the Pennsylvania Railroad, and the Long Island Railroad, and also interchangeable with the Interborough Rapid Transit of New York City.

Between Newfield and Millville and on the stretch of track between Haddon Avenue and South Gloucester is of the span type, an overhead trolley construction is used with poles spaced at a distance of 100 ft., and where practicable the high-tension transmission poles have been used for supporting the span wires. Through Camden the greater part of the trolley construction is

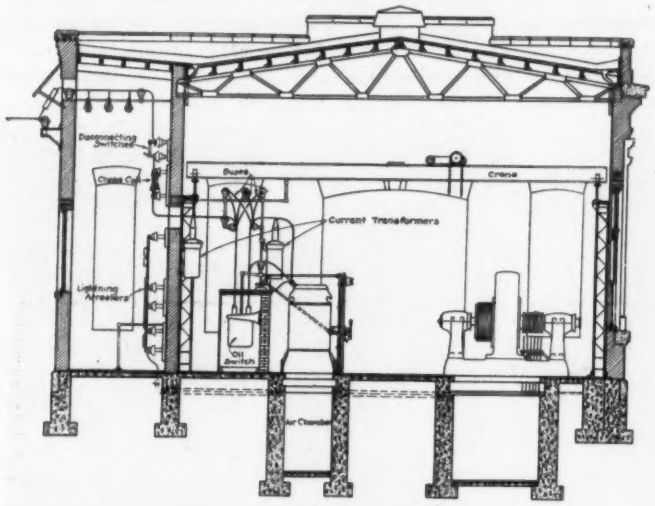


FIG. 6.—TRANSVERSE SECTION OF TYPICAL SUB-STATION.

on tubular steel poles. The trolley is suspended 22 ft. above the top of the track rails.

There are no copper feeders used on the third rail, but those for the trolley lines are as follwos: Two 750,000-cir-mil feeders from South Camden to Haddon Avenue; one 750,000-cir-mil feeder running from South Camden to Brown's Crossing. Both of these form a conjunction with the third rail. The copper feeder between Newfield and Milville is of 500,000 cir. mil section.

The trolley wire is of No. 0000 grooved section. The span wires are of stranded galvanized steel 3/8 in. in diameter. The lightning arresters are installed at approximately 1,000 ft. apart. All pull-offs, strain ears, feeder ears and splicing sleeves are of

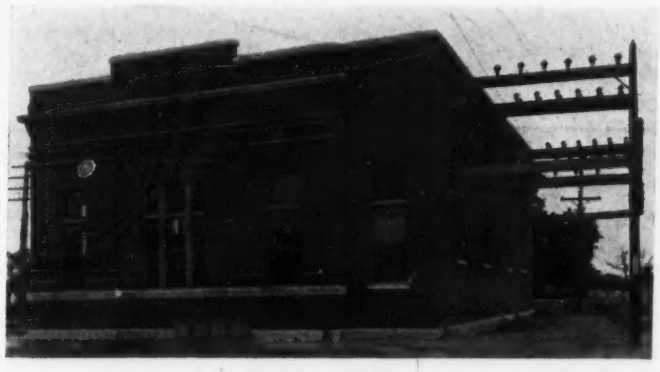


FIG. 7.—VIEW OF EXTERIOR OF GLASSBORO SUB-STATION.

bronze, and as those items, together with all other line material, such as frogs, etc., are of standard pattern, a further description would be superfluous.

For initial service sixty-two passenger cars and six combination baggage and mail cars have been provided. All of the cars are motor cars, the motor and control equipment being the same on all.

In preparing the design of these cars, the engineers of the railroad followed the general design of the standard Pennsylvania Railroad coaches, except that the height is less than the standard to decrease the weight, the shape of the roof is changed and the interior finish is of mahogany instead of oak. The seating capacity is 58 passengers.

Each car is provided with a 50-cp incandescent electric headlight and two electric markers or route lamps on the hood at each end. Each car has two trolleys, each with a retriever, and on the roof between the trolley bases there is a box containing the lightning arrester, trolley cut-out switch and trolley fuse. The cars are heated by Gold cylindrical heaters, one being under each seat, a total of 28 heaters per car. There are two coils in each heater, thus providing three degrees of heat.

The power equipment of each car consists of two General Electric 69 motors which are 200-hp units, while the control system is of the automatic multiple-unit type. The controllers are so arranged that current is cut off from the motors throughout the train and the brakes are applied automatically should the motorman release his hold of the controller handle.

For the sake of brevity, these equipments will not be entered

FIG. 8.—LIGHTNING ARRESTER ROOM, NEWFIELD SUB-STATION.

into in detail, as they are of standard General Electric design. With the exception that each car is provided with a trolley and third rail shoe, the control system is similar to that on the 24 equipments supplied to the Boston Elevated road about eighteen months ago.

The conversion of the lines of the West Jersey & Seashore Railroad above described from steam to electric traction was carried out by the following organizations: The construction of the terminals, inspection sheds, double tracking, changes in existing tracks, grading, new bridges, changes in telegraph lines,

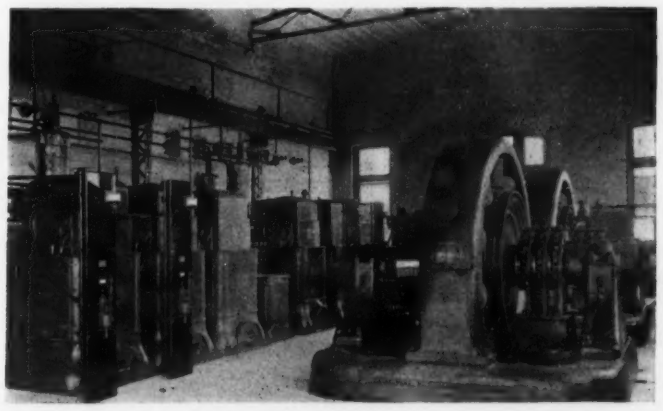


FIG. 9.—VIEW OF INTERIOR OF SUB-STATION AT ATLANTIC CITY.

and installation of a special telephone system were carried out by the regular engineer and maintenance of way departments of the Pennsylvania Railroad Company.

The installation of the interlocking plants and automatic block signaling was carried out by the Union Switch & Signal Company in accordance with plans of the signal department of the Pennsylvania Railroad Company.

The new cars and trucks required for the electric service were designed by the motive power department of the Pennsylvania Railroad Company.

The entire contract for the electrical equipment, including the construction of the power house, sub-stations and the electrical equipment on the cars, was awarded to the General Electric Company, and in accordance with the plans and under the supervision of Mr. George Gibbs, chief engineer of electric traction,

in consultation with the officers of the railroad company. Stern & Silverman, of Philadelphia, were appointed by the General Electric Company as their general sub-contractors, and the Scofield Company, also of Philadelphia, acted as general engineers for the power house and sub-contractors for the piling and foundations.

The whole of the electrical work was under the personal supervision of Mr. W. B. Potter, engineer, railway engineering department, General Electric Company, directly assisted by Mr. J. Elliot Hewes, Mr. C. E. Eveleth and Mr. W. H. Clapp.

The Use of Sodium as Conductor in Place of Copper.

By Anson G. Betts.

THE enormous cost of copper for electrical purposes is a handicap to electrical progress along some lines. If the present rate of progress in electricity is to be maintained or increased, it is necessary to find at least a partial substitute for copper.

Table I gives the conductivity of the common metals with a respectably high conductivity, on the usual basis of comparison,

Table I.—Relative Conductivities

Metal.	Conductivity by weight.	Conductivity by volume.
Sodium	115.	31.4
Calcium	100	45.1
Potassium	86.8	22.1
Aluminum	80.4	63.0
Magnesium	75.5	39.4
Copper	37.5	97.6
Silver	32.5	100.0
Gold	13.6	76.6
Zinc	14.5	29.6
Cadmium	9.7	24.4
Cobalt	6.8	16.9
Tin	6.7	14.4
Iron	6.3	14.6
Nickel	5.0	12.9

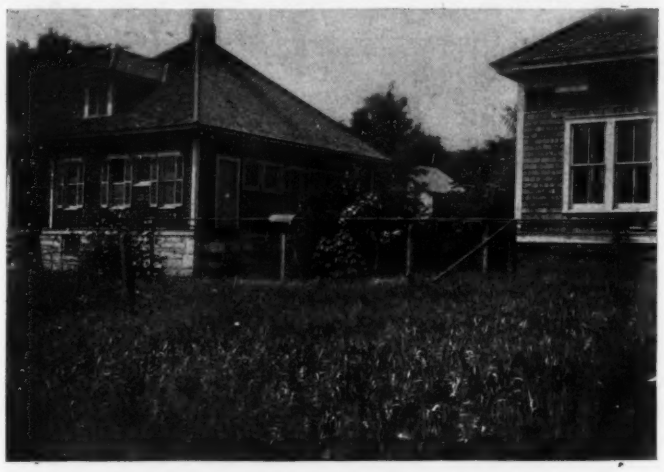
that of volume, and also on the basis of weight, which is really the most suitable for a comparison of this kind, as it is also the commercial basis.

I have seen somewhere a figure for the specific conductivity of beryllium, considerably above that of copper, but do not remember what the figure is, and have not been able to find it again. When the low specific weight of beryllium is considered it will be appreciated that if this material has really a specific conductivity greater than that of copper, it would sell in competition with copper at above a dollar per pound, and would have advantages in machine construction on account of the smaller bulk.

Of the common metals, sodium has the greatest conductivity per unit of weight. Comparing it with calcium, potassium, aluminum and magnesium, which come next, it can also be the most cheaply prepared, and probably always will be because the starting material is so cheap, stable and pure, although potassium alone theoretically requires materially less energy for its production.

The cost of preparation by the Castner process is probably from 10 to 12 cents per pound; certainly not over 15 cents. Production by the Ashcroft process should be accomplished at 7.5 cents or less when the mechanical difficulties of the process are overcome. There are several possibilities in the direct electrolysis of melted sodium chloride, that are well worth careful trial. Five kw-hours per pound of sodium is a fair estimate for the necessary energy, while the cost of salt is slight, and there is also the by-product of chlorine.

The use of sodium as conductor seems dubious at first. This does not arise from the actual merits of the case, but because the idea of using a metal that reacts so violently with water for such a purpose is startling. When we stop to consider we must realize that a great many of our every-day articles of use have very bad faults.



SODIUM CONDUCTOR.

To use sodium as conductor it is only necessary to enclose it in suitable tubes, iron or steel pipe being probably the best. The conductor should be made up in convenient lengths, say the lengths of a railroad freight car, with the ends closed in a suitable manner and provision for connecting the units into a line conductor.

In Table II are given a number of particulars of conductors of standard sizes of wrought-iron pipe filled with sodium. These figures have been got by calculation only, though they have been verified by experiment with one and one-half-inch pipe. The ratio of cost between copper and sodium does not, however, do justice to sodium. With the cheaper sodium we would use a larger capacity in proportion and make a saving in electrical

Table II.—Data of Sodium Conductors.

Size of wrought-iron pipe.	Actual internal diameter, inches.	Thickness of wall, inches.	Internal cross-section area, sq. ins.	Cross sectional area of iron, sq. inches.	Weight of iron per foot, lbs.	Current carried by the iron on basis of 800 amperes per sq. in. copper.	Pounds of sodium per foot.	Current carried by the sodium on basis of 800 amp. per sq. in. copper.	Total current carried by iron-sodium conductor on same basis.	Estimated cost of iron pipes per foot.	Cost of sodium per foot at 7½c. per pound.	Total cost of materials for conductor, per foot.	Cross sectional area of equivalent copper conductor, sq. ins.	Cost of material for copper conductor at 16c. per pound.	Ratio of cost, cost copper conductor=1.
½ in.	.625	.109	.305	.25	.837	29.9 amps.	.128	79 amps.	109 amps.	*at 3c. =2.5c. at 2.5c.	.96c.	3.46c.	.136	8.38c.	.42
1 in.	1.048	.134	.863	.495	1.67	59.2 amps.	.36	222 amps.	281 amps.	=4.175c. (quo. 4c.) at 2.5c.	2.7c.	6.87c.	.35	21.6c.	.32
1.5 in.	1.611	.145	2.038	.797	2.68	96 amps.	.86	526 amps.	622 amps.	=6.75c. at 2.5c.	6.45c.	13.30c.	.78	48c.	.28
2.0 in.	2.067	.154	3.356	1.074	3.61	128 amps.	1.41	864 amps.	992 amps.	=9.0c. (quo. 9c.) at 2.5c.	10.58c.	19.58c.	1.24	76.3c.	.26
3.0 in.	3.06,	.217	7.39	2.24	7.54	269 amps.	3.10	1908 amps.	2177 amps.	=17.85c. (quo. 19c.) at 2.5c.	23.25c.	41.1c.	2.72	$1.67	.25
4.0 in.	4.026	.237	12.73	3.17	10.67	380 amps.	5.35	3270 amps.	3650 amps.	=26.67c. (quo. 27c.) at 2.5c.	40.13c.	66.80c.	4.56	$2.81	.24
5.0 in.	5.045	.259	20.0	4.32	14.5	518 amps.	8.40	5152 amps.	5670 amps.	=36.25c. (quo. 36c.) at 2.5c.	63.0c.	99.25c.	7.09	$4.37	.22
6.0 in.	6.065	.28	28.9	5.58	18.76	670 amps.	12.14	7460 amps.	8130 amps.	=46.9c. (quo. 47c.)	91.05c.	$1.38	10.23	$6.21	.22

Above table is calculated for standard wrought-iron pipe.
For large conductors a lighter pipe would make a correspondingly cheaper conductor.

energy, which would only be partly offset by the extra interest charge on the conductor. To illustrate this suppose we have a $1,000 copper conductor in use. The most economical rate of use is obtained when the cost for interest and power loss are approximately equal. The annual cost would then be: Interest, $60; loss of energy, $60; total, $120. Replacing the $1,000 copper conductor by a $300 sodium conductor the annual cost would then be: Interest, $18; loss of energy, $60; total, $78.

A more economical arrangement would be the use of a $550 sodium conductor, when the annual cost would be: Interest, $33; loss of energy, $32.75; total, $65.75. The table was made out on the assumption that sodium costs seven and one-half cents per pound, which is too low for present market conditions, but it is my belief that sodium will be eventually brought to this figure or lower. On the other hand, the assumed figure for copper, 16 cents, is now too low also. The use of special iron tubes, particularly of the larger sizes, with thinner walls, will reduce the cost somewhat. A simple calculation will show the relative costs of sodium and copper conductors for other assumed or actual costs of the metals.

I constructed a conductor about 130 ft. long in January of this year, using 1½-in. standard wrought-iron pipe of various lengths up to 17 ft., which required about 120 lb. of sodium. I paid the high price of fifty cents per pound for this, but even at that price the conductor would have been considerably less than the price of the copper equivalent, if it had not been for the experimental nature of the work, which meant quite a high cost of construction. The filling of the pipe on a large scale, even with the crude method which it was necessary for me to use, would cost very little.

The method of filling consisted in heating the length of pipe to well above the melting point of sodium, and running melted sodium in from an iron kettle in which it was melted, by means of a small pipe screwed into the bottom of the kettle, with a valve to regulate the flow. At each end of the hot pipe, which was supported with the end farthest from the kettle at a height of a foot or so above the nearest end, an elbow was loosely screwed on, into which were screwed two short vertical lengths of pipe, to hold enough sodium to allow for the contraction in cooling and solidifying, which, however, was not great. When the sodium had risen a little way in the vertical pipe at the far end the flow was shut off. After cooling somewhat the elbows were unscrewed, and the column of sodium cut off with a knife, and the ends screwed on, using graphite and oil mixture to make a tight joint.

The ends were ordinary cast-iron caps, through which passed the copper bolts, turned and milled from a one-inch round copper rod. The conductor was put up outside about the first of February of this year and tested with a direct current of about 500 amp., the temperature being about 0° C. The resistance, leaving out of account two flaws in two of the tubes, which were filled before we got the hang of the apparatus, was .00001 ohm per foot, agreeing exactly with the calculation. There was no appreciable loss at the joints or ends.

The pipes, ten in all, were painted with some paint that turned out to be pretty poor, and have been out in the weather now for about nine months. Some of them have rusted a little, but that is the fault of the paint. If they are properly taken care of I see no reason why they would not last indefinitely. So far there has been no apparent change in the conductor, except the rusting.

The conductor is shown in the photographic reproduction connecting the two buildings of my laboratory. It was removed after several months and put on supports in a field near by to observe the effect of the weather.

It is important to recognize the limitations of the sodium conductor. One is that it is limited to heavy work, above ground. The only other one appears to be that it may not be used in proximity to wooden or non-fire-proof buildings. In case of a fire in the neighborhood of the conductor the heat might expand the sodium enough to burst the pipe and let it run out. In the absence of water this would merely burn like so much zinc, but conditions would be very dangerous if it was attempted to put the fire out with water. For that reason I took the conductor away from the laboratory. There might have been a fire from some other cause, when it would not be safe to try to put the fire out.

However, for transmission lines through the country and feeders for railroads along the right of way, this objection would not hold.

Particular methods of construction, support and insulation are of minor importance, because there are plenty of solutions for them, which need not be described at this time.

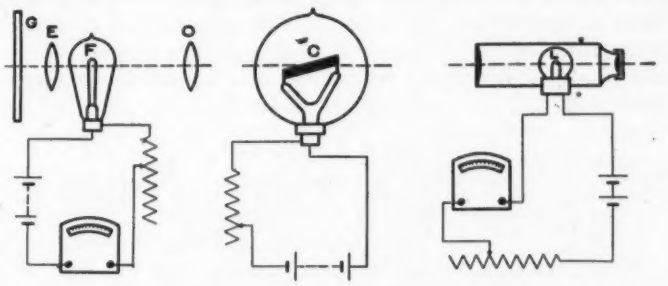
Preliminary Measurements on Temperature and Selective Radiation of Incandescent Lamps.*

BY C. W. WAIDNER AND G. K. BURGESS.

THE high efficiency attained in some recent metal filament lamps raises the question whether this is to be attributed to selective radiation or to a higher working temperature of the filament, or to both. In this region of high temperatures almost no data are available bearing on this question, and we have, therefore, thought it worth while to communicate some preliminary results obtained with filaments of carbon, tantalum and tungsten.

TEMPERATURE MEASUREMENTS.

The filament, *F*, of the lamp under observation is mounted in front of the carbon ribbon, *C*, which is itself within an evacuated globe, in such a way that by means of the lenses *O* and *E* the



ARRANGEMENT OF APPARATUS.

filament is seen superimposed on the carbon ribbon, *C*. This ribbon may be heated electrically to any desired temperature, which is measured by means of the Holborn-Kurlbaum optical pyrometer†' the principle of which is briefly as follows: The current in the pyrometer lamp, *L*, is adjusted until the filament is of the same brightness as the incandescent body under observation. From a previous calibration by comparison with thermo-couples and a black body source, the relation between the current in the filament and its equivalent black body temperature is known.

An observation at one temperature consists in setting the two filaments, *F* and *L*, to the same brightness as *C*, and measuring the currents in *F* and *L*. The temperatures of *C* and of *F* are then known from the calibration of *L*. From a series of such measurements at different temperatures the temperature current curve for the filament *F* may be drawn.

Temperature Scale.—The lamp *L* being calibrated by comparison with a black body, when sighted on another incandescent body, reads not its true temperature, but something lower, by an amount depending on the emissive power of the body. By the term *"black body temperature"* is, therefore, meant the temperature at which a black body would send out radiation of the same intensity as that from the object observed for a given wave length. A body at a given temperature will in general have a different black body temperature for each color, that for red being lower than for green or blue. In this paper the term *temperature*, unless otherwise qualified, is taken to mean the black body temperature Centigrade, as given by an optical pyrometer using red light, $\lambda = 0.66\,\mu$.

* Communication from the Bureau of Standards.
† The subject of Optical Pyrometry is treated at length in Bulletin, Bureau of Standards, Vol. I, pp. 189-254, 1905.

To study the selective radiation for different colors, the filament *F* was calibrated with red, green and blue light, obtained by interposing monochromatic glasses at *G*.

The measurements were made in the range 700°-1,850° C., which was the safe upper limit of the carbon ribbon, *C*. Higher temperatures of F. were then obtained by extrapolation of the current temperature relation. As to the reliability of such extrapolation we have found that lamps calibrated to 1,300° were still in agreement to within 1° or 2° when extrapolated for 300°, and further that these extrapolations are in satisfactory agreement with other methods of measuring temperature.

Precision of Method.—As an illustration of the results attainable by this method we cite the measurements made on a 100-volt metal filament lamp, very probably tungsten.

Table I.
Calibration of Metal Filament Lamp, No. 11. (Red Radiation.)

Current in filament.	Observed temperature of filament.	Calculated temperature.	Obs.—calc.
0.1302	847°	848.2	—1.2
.1510	921°	919.2	+1.8
.1895	1049°	1051.2	—2.2
.2270	1166°	1167.2	—1.2
.2625	1267°	1269.9	—2.9
.3144	1413°	1410.7	+2.3
.4013	1621°	1625.2	—4.2
.4561	1750°	1750.2	— .2
.4812	1811°	1805.7	+5.3

These observations satisfy the following equation:

$$I = -0.0285 + 0.0001041\,t + 0.0000000990\,t^2$$

for red radiation ($\lambda = .66\,\mu$), where I is the current in amperes and t is the temperature.

SELECTIVE RADIATION.

Regarding the significance of selective radiation and its bearing upon the problem in hand, the radiation of platinum for red, green and blue, as compared with black body radiation, may serve as an extreme illustration. In the following table are grouped some results obtained from measurements of the black body temperatures of platinum for red, green and blue, at various known temperatures.

Table II.
Radiation from Platinum.

Actual temperature of platinum.	Black body temperatures		
	Red $\lambda = 0.66\mu$	Green $\lambda = 0.55\mu$	Blue $\lambda = 0.47\,\mu$
1100°	1008°	1029°	....
1400	1255	1285	1300
1700	1505	1545	1575

We may interpret these results as follows:

As a first approximation suppose that the platinum is at a true temperature of 1,700°, then its radiation for green light is equal in intensity to the radiation of a black body at 1,545°. The platinum radiation will be somewhat greater than that of this black body for blue light (viz.: equivalent to a black body at 1,575°) and somewhat less for red (viz.: 1,505°). The total luminous radiation of the two is, therefore, not very different, and as the maximum sensibility of the eye is in the green their photometric appearance will be very nearly alike. Now the maximum energy for both is in the infra red, and for these long wave lengths the black body temperature of the platinum falls still more behind that of the black body. It will be seen, therefore, that the energy of luminous radiation is distributed more favorably for platinum than for a black body.

In the calibration of the carbon filament pyrometer lamps against a black body, no appreciable difference (less than 2° C.) could be detected in the current temperature calibration equations using red, green and blue light. It does not follow from this, however, that the radiation from carbon is the same as that from a black body; on the contrary, carbon is known to depart considerably from ideal blackness, although in the visible spectrum it shows no appreciable evidence of selective radiation; and for this reason is sometimes called a "gray body."

TUNGSTEN LAMPS.

Four tungsten filaments gave the following current temperature relations, where I is the current in amperes in the filament and t is its corresponding black body temperature for the radiation (color) studied.

Table III.
Equations for Tungsten Lamps.

Lamp No.	Color.	Equation.
1	Red	$I = 1.008 - 0.0_3391\,t + 0.0_6548\,t^2$
5	Red	$I = 1.344 - .0_3396\,t + .0_6518\,t^2$
18	Red	$I = 0.802 - .0_3437\,t + .0_6490\,t^2$
10	Green	$I = 0.775 - .0_3390\,t + .0_6465\,t^2$
10	Blue	$I = 0.644 - .0_3225\,t + .0_6411\,t^2$
11	Red	$I = -.028 + .0_3104\,t + .0_7990\,t^2$
11	Green	$I = -.060 + .0_3152\,t + .0_7781\,t^2$
11	Blue	$I = -.056 + .0_3148\,t + .0_7778\,t^2$

All but lamp No. 11 were low-voltage experimental lamps designed with a view to studying the behavior of tungsten at high temperatures. The experimental data for lamp No. 11 are given above. (See Table I *et seq.*)

At normal voltage (100 v.) the current in this lamp was 0.644 amp., from which the corresponding temperature given by its equation is 2,135° C., indicating a true temperature of the filament of about 2,300° C. (See Table IV.) At 100 volts the candlepower of this lamp was 68 and its specific consumption 0.95 watts per candle (mean horizontal), from data furnished by Dr. Hyde, of the Bureau of Standards. Lamp No. 10 was burned at a temperature of 2,400° C. (about 2,570° C. true temperature) for 1½ hours when it burned out.

Selective Radiation.—The selective radiation of tungsten was studied as in the case of platinum by measuring the black body temperatures of the filament for red, green and blue light. The results as given by the equations of Table III are shown in Table IV.

Table IV.
Selective Radiation of Tungsten.

Lamp No.	Black body temperatures: Red (λ=0.66)	Green (λ=0.55)	Blue (λ=0.47)	Approx. true temperatures.
10	1300° C	1310° C	1319° C	1355° C
11	1300°	1311°	1319°	1355°
10	1700°	1714°	1723°	1770°
11	1700°	1724°	1734°	1800°
10	2100°	2123°	2141°	2220°
11	2100°	2146°	2161°	2280°
10	2500°	2532°	2565°	2690°
11	2500°	2576°	2594°	2780°
10	2900°	2943°	2994°	3180°

The appearance of the filament of lamp No. 11 when cold was more polished than that of No. 10, and the table shows No. 11 to act the more like a bright metal such as platinum. Another lamp whose filament resembled that of No. 10 gave sensibly identical values with the latter. The last column in Table IV giving the approximate values of the actual temperatures of the tungsten filaments is obtained by adding to the black body temperature for blue light, twice the difference between the readings for red and blue light, a relation found to hold fairly well for platinum, which shows this selective effect much more than does tungsten. (See Table II.)

A filament, the composition of which was stated to be 30 per cent of tungsten and 70 per cent of zirconium nitrate, gave practically the same selective radiation as tungsten. When run at a temperature somewhat above the normal working temperature of the tungsten lamp, a rapid deterioration of the filament took place, accompanied by the formation of an irridescent deposit on the bulb.

Melting Point of Tungsten.—By noting the current required to burn out a tungsten lamp and substituting in the proper current temperature equation (Table III) an idea of the melting point of tungsten may be obtained. Lamps 1 and 5 were burned out at temperatures of 2,950° C. and 2,850° C., respectively, which indicates a mean true temperature of about 3,200° C. for the melting point of tungsten. Both filaments formed shiny beads indicating a real melting and not a disintegration due to evaporation as in the case of carbon filaments. There was no appreciable deposit in the bulbs after burning out. It would appear that tungsten has the highest melting point yet measured.

TANTALUM LAMPS.

We have thus far examined only two tantalum lamps, whose current temperature equations are given in Table V.

Table V.
Equations for Tantalum Lamps.

Lamp No.	Color.	Equation.
8	Red	$I = -0.0125 + 0.0_4538\,t + 0.0_7840\,t^2$
8	Green	$I = -.0392 + .0_4901\,t + .0_7687\,t^2$
8	Blue	$I = -.0607 + .0_3125\,t + .0_7531\,t^2$
9	Red	$I = -.0176 + .0_4617\,t + .0_7810\,t^2$

The filament of No. 9 had been broken and reweided by shaking. No. 8 was the ordinary 110-volt lamp. At 110 volts the current was 0.380 amp., indicating a temperature of 1,865° C., or a true temperature of about 2,000° C. (see Table VI). This lamp was heated for one hour at the normal temperature of the tungsten lamp, 2,135° C., after which a recalibration showed a marked increase in temperature (about 2 per cent) for a given current. A further two hours' heating at the same temperature showed a further rise of 1 per cent. After standing ten days it recovered almost completely; the temperature of normal burning (110 v.) as determined from a new calibration being 1,870° C. Lamp No. 9 was burned at 2,200° C. for seven hours and showed

the same phenomena, but to a greater extent, and there was a very marked blackening of its bulb.

The increase in efficiency of these metal filament lamps in the early stages of burning is well known. The above experiments indicate a rise in temperature during this stage of the burning. Sufficient data are not yet at hand to determine whether this is due to a smoothing of the surface with use as has been suggested or to an improvement in the vacuum with burning. If the increase in efficiency is due to an increase in the polish of the surface, and therefore in the selectivity of the radiation, it would probably result in further separating the red and blue calibration curves.

Selective Radiation.—In Table VI are given the results of measurements on the selective radiation of tantalum, as obtained with lamp No. 8.

TABLE VI.

Selective Radiation of Tantalum.

Black body temperatures			Approximate true temperature.
Red λ=0.66	Green λ=0.55	Blue λ=0.47	
1300° C	1320° C	1330° C	1360° C
1700°	1727°	1752°	1800°
2100°	2147°	2198°	2300°

CARBON LAMPS.

For the sake of comparison with the metal filament lamps a study was made of the temperature behavior of some of the ordinary types of carbon filament lamps, including 4, 3.5 and 3.1-watt lamps. The current temperature equations of five of these lamps are given in Table VII.

TABLE VII.

Equations of Carbon Filament Lamps.

Lamp No.	Type: Volts.	Type: Watts.	Equation.
3	50	4	$I = 0.156 - 0.0_8223t + 0.0_8532t^2$
4	50	4	$I = .092 - .0_4860t + .0_4460t^2$
6	50	4	$I = .087 + .0_4592t + .0_3388t^2$
7	50	4	$I = .166 - .0_8140t + .0_4394t^2$
7	After	2200°	$I = .066 + .0_8109t + .0_4352t^2$
13	110	3.1	$I = .067 + .0_4916t + .0_8156t^2$

With a view to determining the maximum temperature attainable with carbon filaments, several of these lamps were burned out by quickly increasing the current.

Owing to the rapid deterioration of the carbon filament the maximum temperature that can be attained depends on the rapidity with which the temperature is raised, the thickness and condition of the filament, etc. For these reasons it is impossible to state with precision the temperature at which the filament finally breaks down, as the calibration equation no longer applies but serves nevertheless to define a lower limit of the temperature of destructive disintegration, which varied between 2,500° and 2,800° C. for these lamps. At the normal working temperature of the tungsten (2,135°) the carbon lamp shows rapid deterioration.

The normal burning temperatures of lamps 3, 4, 6 and 7 ranged from 1,695° to 1,720°. Lamp No. 7 was burned at 2,200° for 15 minutes and on recalibration showed a normal temperature of 1,670°, or 40° lower than before. It was again heated one hour at 2,200° when it broke down at the pasted junction. The bulb showed considerable blackening and the resistance of the lamp rose from 36.7 to 41.5 ohms.

NORMAL TEMPERATURES.

The following table gives the normal burning temperatures of both the metal filament and the carbon lamps examined.

TABLE VIII.

Normal Burning Temperatures.

Type of lamp.	Watts.	Volts.	Observed black body temps. (red).	Approximate true temperatures.
Carbon	4	50	1710° C	1800° C
Carbon	3.5	118	1760°	1850°
Carbon	3.1	118	1860°	1950°
Tantalum	2.0	110	1865°	2000°
Tungsten	0.95	100	2135°	2300°

GENERAL DISCUSSION.

At a given true temperature the total energy of thermal radiation as well as that of the radiation for every wave length emitted per unit area by a black body, is greater than that of any other known body. No conclusive experimental evidence has yet been brought forward in contradiction to this general statement. On account of the very large proportion of the energy of total radiation that exists as the longer wave lengths of the infra red portion of the spectrum that do not excite the sensation of light in the eye, a black body is an inefficient luminous radiator.

Of all metals that can be raised to even a moderately high temperature (say, 1,500° or more) platinum departs farthest from black body radiation. For a given true temperature it radiates less total energy, and a larger porportion of this energy exists in the form of the shorter wave lengths which excite the sensation of light. This is the sense in which the term *selective radiation* is here used. If platinum could withstand the high temperatures at which these modern metal filament lamps can be worked it would, therefore, have an appreciably higher efficiency than they have. In this sense all solid substances show, in varying degrees, selective radiation and all are more efficient luminous radiators than a black body. For these reasons carbon, which is one of the closest approximations to a black body, is a less efficient luminous radiator than the metals. It should be remembered, however, that at the same true temperature a carbon filament would emit more light than these metal filaments, although on account of the greater selective radiation of the metals as shown above it would be less efficient.

In much of the literature on this subject the marked gain in efficiency of the metal filament lamps is attributed almost entirely to selective radiation, and it is often implied that the radiation is not only selective in the sense above discussed, but similar to that of a gas, which, when electrically excited, can emit strongly in one region of the spectrum while the radiation may be entirely absent for large regions. In support of this view the statement is often made that the character of the light from the tungsten filament is more greenish in appearance than from a carbon filament or from a tantalum filament unless there is a considerable effect of this kind in the infra red.

In this connection it should be stated that a few preliminary measurements made on the Nernst glower at low temperatures seem to show that there is an appreciable increase in the selective radiation for green light, the black body temperature for green light being almost or quite as high as for blue, which is in agreement with the experiments of Kurlbaum and Schulze.* The nature of the conduction and of the chemical processes here involved is as yet but little understood. The undue increase in the emission for green light might suggest the combined effects of radiation from a solid and from a gas. The experiments of Kurlbaum and Schulze show that this effect almost disappears at higher temperatures, and the important fact remains that it is not this type of selective radiation that contributes materially to the efficiency of any of the metal filament lamps.

The measurements above cited show that tantalum is more selective in its radiation than is tungsten and in all probability would be more efficient than tungsten at the same true temperature. The great gain in efficiency in the tungsten lamp over the tantalum lamp must, therefore, be attributed to the very much higher temperature at which the tungsten can be worked continuously. Likewise the marked increase in efficiency shown by both tantalum and tungsten lamps over carbon filament lamps is to some extent due to selective radiation, but is rendered possible to a greater extent from the fact that they can be operated at a higher working temperature. The marked gain in efficiency resulting from an increase in the temperature is at once evident from the fact that at the working temperature of these lamps the intensity of the light emitted varies about as the twelfth power of the temperature while the electricity supplied to the filament varies as a much lower power of the temperature, something of the order of the fifth, varying with the material of which the filament is constructed and the nature of its surface. This is also illustrated by some measurements made by Dr. Lederer† on osmin lamps, from which it follows that the light increases as the 4.4 power of the voltage, while the consumption of electricity varies only as the 1.5 power of the voltage.

If a very considerable part of the gain in efficiency in the metal filament over carbon filament lamps is to be attributed to the higher working temperature at which they may be operated it may at first sight seem that this conclusion is at variance with the relatively high efficiency of these metal filament lamps in comparison with electric arc lamps where the luminous radiation comes from a source whose temperature is more than 1,500° higher. In the arc lamp, however, the loss of power by the conduction and radiation of the carbons and by convective circulation is so great that this fact is readily explained.

We are indebted to Mr. J. W. Howell for the carbon ribbon lamps and to Mr. J. A. Heany for most of the tungsten lamps.

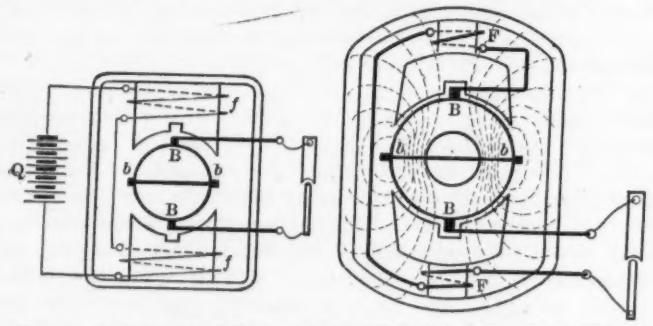
* Kurlbaum and Schulze: Verhandl. d. Deutsch. Phys. Gesell. 5, 428, 1903.
† Libesny-Electrotecknik und Maschinenbau, 21, p. 438, 1906.

Constant Direct-Current Dynamos.

By Dr. E. Rosenberg.

In the following paper are discussed the field of application and a few modifications of a new type of direct-current machines invented by the author, the application of which for train lighting was mentioned in a short abstract in the Electrical World and Engineer of 1905, Vol. 46, page 104. The fundamental characteristics of the machines, according to which they tend at all times to deliver a current of constant strength, were treated in the abstract and need not be repeated. It may be well, however, to outline briefly the chief operating feature of the machines.

Fig. 1 shows a two-pole dynamo, the field coils of which, *f*, are excited separately (in the illustration by an accumulator battery, *Q*). The brushes, *b b*, being placed at the usual points, are short-circuited and serve merely the purpose of producing, by the m.m.f. of the current flowing between them, a cross field at right angles to the main field. The motion through the cross field causes the production of the useful e.m.f. in the armature, the current being collected by the brushes, *B B*, which are displaced from the auxiliary brushes by one-half of the pole distance. From the main brushes, *B B*, the outer circuit is fed (in the diagram Fig. 1 an arc lamp). The current collected by the brushes, *B B*, cannot exceed a certain value, for this current magnetizes the armature in a direction exactly opposite to that of the main field.



FIGS. 1 AND 2.—MACHINES WITH SEPARATE AND WITH SERIES EXCITATION.

For the sake of convenience the machine will be termed the REG dynamo, as is the case with most of the machines built according to this system at the works of the Allgemeine Elektricitäts-Gesellschaft in Berlin.

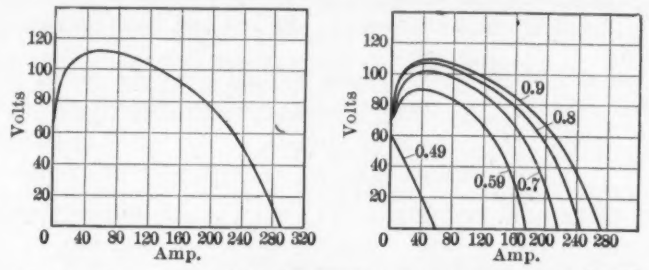
SERIES EXCITATION.

With the arrangement described it is necessary to have available a source of continuous current for the excitation of the machine; this is the case, for instance, on board trains, where storage batteries are used.

The dynamo described can, however, conveniently be built for series self-excitation; the characteristic of such a dynamo may be made such that it can be used not only for shunt—and differential—but also with great advantage for series lamps. Such a machine is provided with a series winding, the area of the pole cores is made small, while the pole shoes are so shaped that the cross field of the armature can develop itself into a powerful counter stray field (see diagram Fig. 2). The field and armature turns are transversed by the same current; the number of turns on the field coils being made larger than the effective number of armature turns.

First of all, the main field preponderates so that initially the voltage of the machine increases with increasing current. At a comparatively small current the iron of the main field is strongly saturated so that a further increase of the current strengthens the main field only a little, while the cross field flows through the large area of the armature and the pole shoes; thus the stray field indicated in Fig. 2, which acts in opposition to the original field increases nearly in proportion to the armature current. It is obvious that owing to this design the machine has a drooping voltage current characteristic. Starting from a certain small current the voltage will fall with growing current and even with direct short-circuit does not exceed a certain harmless value. In Fig. 3 is shown the characteristic of a dynamo with series connection for a normal output of 60 volts and 200 amp., the main currents being plotted as abscissas, the corresponding voltages as ordinates.

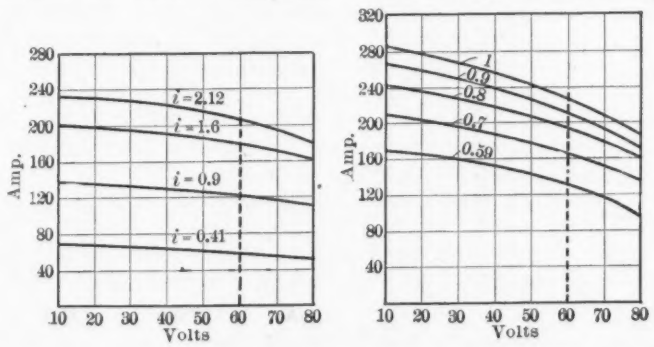
In Fig. 4 a set of curves is plotted showing the characteristics of the same machine with various resistances connected in parallel with the field winding; the field currents are then no longer equal to the armature current, but respectively 0.9, 0.8, 0.7, 0.59, 0.49 of the latter. It will be seen that the current can be adjusted to any value desired by means of adjusting the excitation (parallel resistance) so that a machine built for 200 amp. may also be used for 150, 100 amp. or a still smaller current.



FIGS. 3 AND 4.—VOLT CHARACTERISTICS OF MACHINE WITH SERIES EXCITATION.

The voltage produced with open circuit may be varied at will, and, according to the purpose for which the machine is required; this is done in the following manner: Firstly, by selecting the material for the main field core and the pole shoes. As is well known, cast iron has a considerably larger residual magnetism and coercive force than cast steel or wrought iron. If now, with open main circuit, a large voltage is required the magnet frame or at least parts of it must be made of cast iron. The extra weight does not play an important part, as in any case the cross-sectional areas may be made exceedingly small.

The no-load voltage may also be greatly influenced by a small displacement of the brushes. If the brushes are placed not exactly in the neutral zone, but slightly forwards or backwards, so that the axis of the auxiliary brushes is not absolutely perpendicular to that of the main field, the field of the cross armature current will have a component which directly strengthens or weakens the residual field and allows of far-reaching variations. By this component of the cross field as well as by the respective component of the counter stray field a certain though smaller influence may be exerted on the drooping voltage current characteristics.



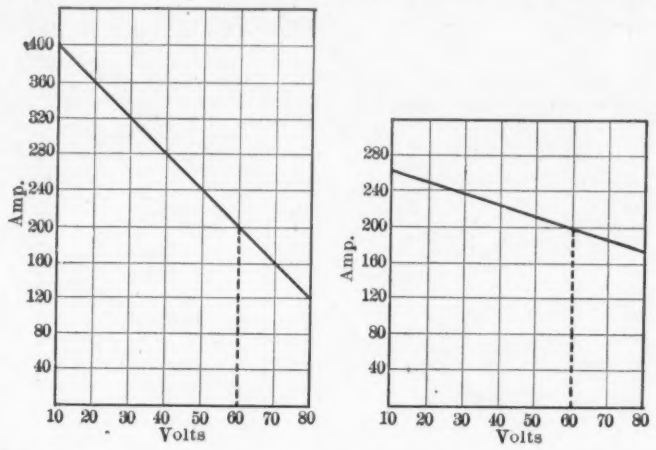
FIGS. 5 AND 6.—CURRENT CHARACTERISTICS OF SEPARATELY AND SERIES-EXCITED MACHINES.

By suitably dimensioning the individual parts it is quite possible to let the short-circuit current of the machine exceed the useful current at normal voltage by any required amount, say, 25, 50 or 100 per cent., and on the other hand to let the maximum voltage which the machine produces at small load exceed the normal voltage by 100 or 50 per cent. The voltage characteristic may also be formed so that for the working part of the curve the increase of current is nearly exactly proportional to the decrease of voltage. The machine for these voltages and currents is then one for constant output, and is thus well and equally suitable for feeding shunt, series and differential lamps.

ARC LAMP DYNAMOS.

We shall now examine the behavior of an arc lamp if connected without a resistance to a dynamo with either separate or series

excitation and shall consider also its behavior when connected to a source of constant voltage in series with a regulating resistance. For an easy comparison in Figs. 5 and 6 the voltages on the arc lamps are plotted as abscissas, the currents as ordinates. As a starting point there has been chosen a voltage of 10, as this is



FIGS. 7 AND 8.—CURRENT CONSUMPTION OF ARC LAMPS AT CONSTANT VOLTAGES.

approximately the voltage indicated on the terminals of the arc lamp with the carbons pressed against each other.

Fig. 5 refers to a separately excited machine, the dynamo voltage and lamp voltage being identical; Fig. 6 refers to a machine with series excitation. This curve is taken directly from Fig. 4. For the sake of comparison, Fig. 7 shows the currents corresponding to the different voltages for an arc lamp designed for 60 volts and 200 amp. normal current connected in series with a constant resistance of 0.25 ohm to a 110-volt main; Fig. 8 shows the same for a main voltage of 220 and a series resistance of 0.8 ohm. From comparison with the curve marked "0.9" in Fig. 6 it is seen that the lamp which is connected directly to the series excited dynamo shows nearly exactly the same variations of current as if it were connected, according to Fig. 8 to 220 volts and in series with a resistance consuming three times as much power as the lamp. With a separately excited dynamo (see Fig. 5) the deviations are even considerably less. The variations of current become larger beyond all comparison if the lamps are connected to a 110-volt circuit in series with a resistance consuming 80 per cent of the power (see Fig. 7).

Fig. 10 shows the strength of current as a function of the length of arc for a 75-amp arc lamp connected to a separately excited dynamo. These curves and the ones of Fig. 11 have been communicated to me by Mr. Coubrough, chief electrician of Messrs. Mather & Platt, Manchester, who are the English licensees for this machine. The curves are plotted for three different exciting currents and for arc length of 0.22 mm. From the upper curve it will be seen that the current which with touching carbons was 85 amp. fell to 75 amp. with an arc length of 6 mm. and to 68 amp with an arc length of 22 mm.; thus during this enormous variation of the length of arc the variations of current have not been more than 13 per cent.

In the curves of Fig. 11 marked 220, 100, REG are shown the watt consumptions of the lamp as a function of the arc length. (1) with the lamp being connected with a series resistance across 220 volts; (2) across 100 volts; (3) without a series resistance to an REG dynamo. In addition to the fact that with normal current the watt consumption is considerably larger in the first two cases, it will also be seen that with a shortening of the arc the consumption increases in the first two cases, while it naturally decreases with the REG dynamo.

Rushes of current and power are thus entirely avoided with the REG dynamo. With regard to the handling of the lamp the machine offers a great advantage inasmuch as there is neither a regulating resistance in the lamp circuit nor even a switch, provided a separately excited REG dynamo is used; the starting and stopping of the lamp, as well as the adjustment of the current to any desired value, is effected simply by handling the shunt regulator. The curves in Figs. 4 and 5 show that the machine works just as steadily with reduced as with full excitation.

DYNAMOS FOR WELDING.

In principle there is no difference between machines for feeding arc lamps and those for arc welding, except that the currents are considerably larger in the latter case and thus the consumption of power is a chief consideration. The voltage is about the same as that for feeding single arc lamps. For welding dynamos the series excitation is particularly suitable, as it is here very desirable during the contact of the electrodes for the current to rise to about 1½ times the normal. In this way the arc is formed more readily. Compared with the machines at present used for welding

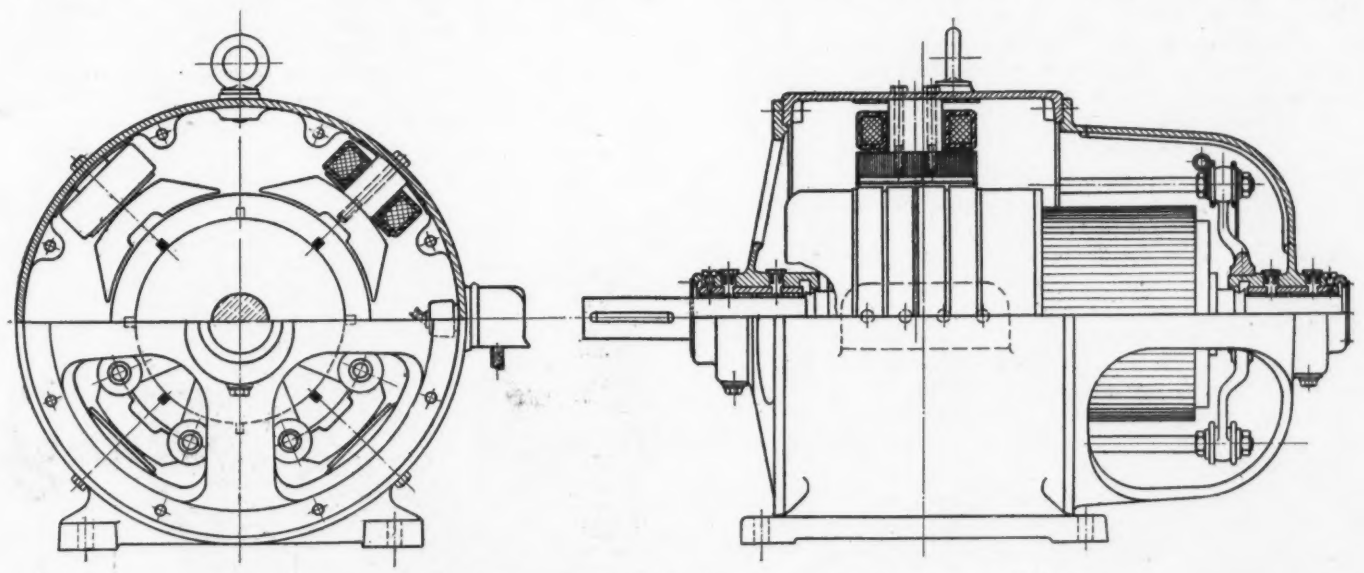
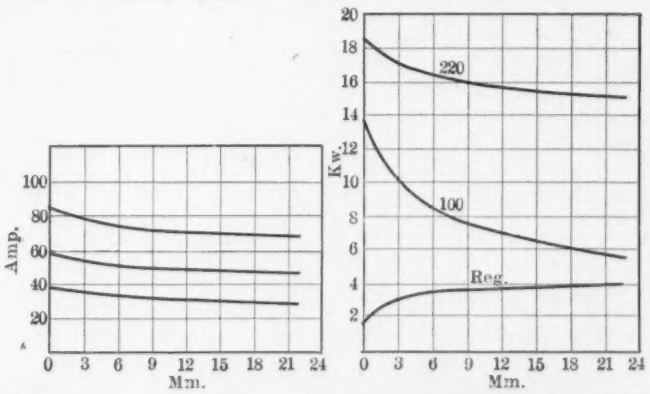


FIG 9.—SECTIONAL ELEVATIONS OF SERIES-EXCITED DYNAMO DESIGNED FOR WELDING.



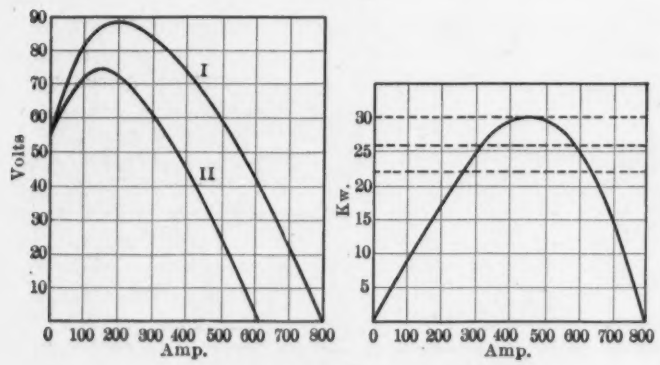
FIGS. 10 AND 11.—CURRENT AND POWER CONSUMPTION OF ARC LAMP.

this machine has very important advantages. Fuses and automatic cut-outs are superfluous, for under no conditions can the current reach an excessive value. The power produced by the dynamo is largest when the arc has the proper voltage; with moderate variations upwards and downwards the dynamo power hardly varies, while with a great increase or decrease of the current it will fall considerably. With short-circuited mains the dynamo requires nearly as little power for driving as with open-circuited mains. Naturally the cross-section of the yoke is thus unnecessarily large.

Fig. 9 shows a dynamo designed especially for welding. The machine has four poles, the thin yoke and the small pole cores are cast in one piece, while the laminated pole shoes are fixed by means of screws. The dynamo is built for series excitation. Its characteristics, i. e., the voltage as a ratio of the main current, are shown in Fig. 12; curve *I* refers to the machine running without parallel resistance, curve *II* with a resistance parallel to the exciting coils. Fig. 13 shows the output as a function of the external current for full excitation. The maximum output, viz.: 30 kw, is reached with a current of 450 amp. If the resistance is increased beyond a value corresponding to this current the dynamo output is decreased. The current may, however, vary around this value within wide limits without causing the output of the dynamo to vary greatly. Considering 26 kw as the normal output (represented by the central dotted line) we see that the current may assume any value between 260 and 635 amp. without the output of the dynamo varying by more than 15 per cent of the normal. From Fig. 12 it is seen that under these conditions the voltage varies between 86 and 35. Thus the dynamo represents in this construction a machine for constant output within wide limits. The machine is also applicable for electric furnaces of all types in so far as they are fed by continuous current.

In regard to the behavior of the commutator of the machines, it may be stated that since the m.m.f. of the useful armature current is overcompensated, and the main brushes are situated in a commutation field which is sufficiently weakened by the slot in the center of the pole, it follows that the commutation of these machines is excellent, provided they are designed correctly. Thus in the large number of machines built hitherto no special devices were required to improve the commutation. Whether it will be necessary to provide high-tension machines of, say, several thousand volts, with special commutating devices is a question to be solved by the further development of these machines, which may be required for series circuits. In this case small separate commutation poles may be provided with coils transversed by the main current for the main brushes and by the auxiliary current for the auxiliary brushes.

As to the heating of the commutator whose sets of brushes are practically equally loaded at normal voltage and normal current, the heating is not sensibly altered when the current collected by

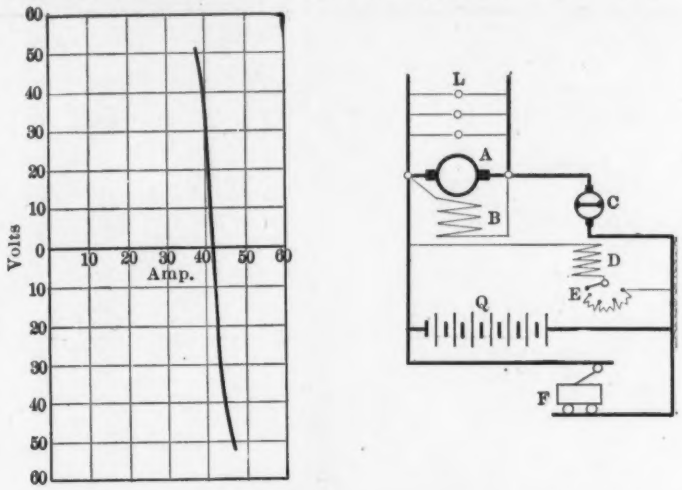


FIGS. 12 AND 13.—CHARACTERISTICS OF WELDING DYNAMO.

one set of brushes rises while that collected by the other set falls, provided, of course, that both currents are within the limits of sparkless commutation. This latter is the case at all possible loads.

AUTOMATIC BOOSTERS.

Both with the self-excited and the separately excited REG machine a certain definite value of current is always obtained on short-circuit. With decreasing current the main field preponderates over the counter stray field in such a way as to cause the voltage to increase. But what will happen if the current increases over the critical value? The counter stray field will then obviously preponderate over the main field, the consequence being a production of negative voltage. This case is not merely a mathematical abstraction, but a practical possibility, provided current is sent through the machine. We may connect the REG machine as a reversible booster between two sources of current of variable voltage, for instance between a 250-volt dynamo and a battery of 110 cells, the voltage of the former being varied be-



FIGS. 14 AND 15.—CURRENT CHARACTERISTICS AND CIRCUIT CONNECTIONS OF A BOOSTER MACHINE.

tween 200 and 300. If the battery voltage and the dynamo voltage are alike, a certain current, viz., the short-circuit current, will flow through the REG booster, since the potential of the main brushes is the same, exactly as if they were short-circuited by a wire. When the battery voltage is larger than the dynamo volt-

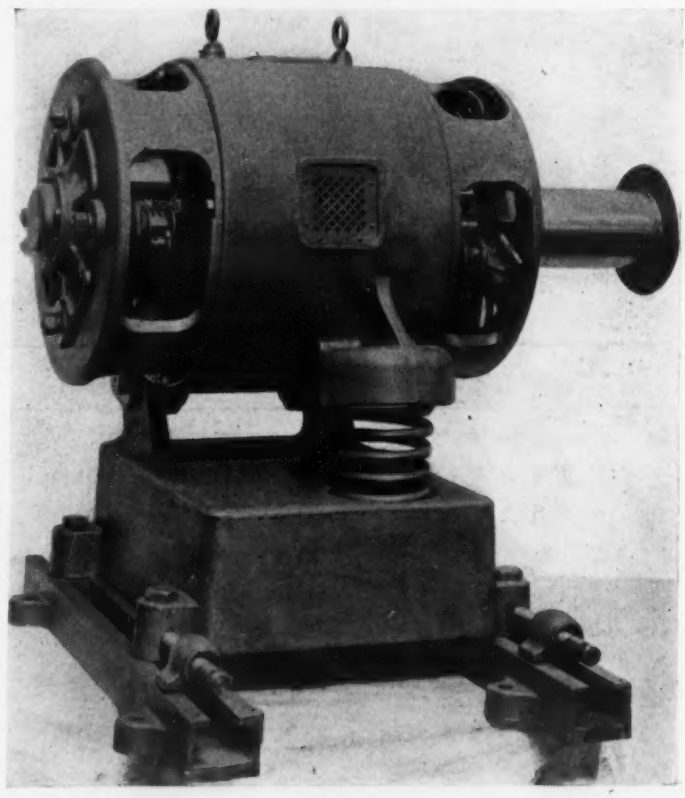


FIG. 16.—TRAIN LIGHTING DYNAMO FOR BELT DRIVING.

age the current flowing through the REG machine will become somewhat smaller, the main brushes consequently supplying a positive voltage. When the battery voltage is smaller than the dynamo voltage the current flowing through the REG dynamo will increase slightly; the main brushes will supply a negative voltage, i. e., the REG dynamo will consume part of the voltage supplied by the main dynamo and will run thus as a motor. Fig.

14 shows the characteristic obtained from a separately excited REG dynamo under the conditions here assumed.

When using the machine as an ordinary booster for charging accumulators no regulation is required during the progressing charging process. According to the design of the machine the current decreases with progressing charging either very little or at a certain predetermined rate, the voltage of the dynamo adjusting itself to the battery voltage. In the case of railways or elevators or any other apparatus having a very irregular consumption of current, the rushes of current may be taken up by a buffer battery and an REG dynamo may be inserted between the battery and the mains (see Fig. 15). The dynamo will then supply the mains during the whole day with the average current required. The battery voltage will vary between the charging and discharging voltage, while the REG dynamo works with the instantaneous difference between the battery and supply voltage as either a dynamo or a motor, the current passing from the dynamo to the mains being nearly constant.

In the following a few more applications of the REG dynamo are mentioned briefly:

It may be used as generator for vehicles with electric transmission of the driving power. For this purpose the series excitation is most suitable because this type gives a nearly constant output for widely varying currents and because with this excitation an overloading of the driving engine is avoided. Thus it is very suitable for direct coupling with an oil engine producing the power for the driving motors. In climbing steep hills, which will cause an increase of the motor current, the dynamo voltage will fall automatically. Regulating resistances are hereby superfluous. The motors can be connected directly to the running generator by means of a simple switch.

Motors for pumps, ventilators and, under certain circumstances, also lift motors which are placed at a great distance from the generators, may be fed from REG dynamos, the expensive automatic starters not being required in this case. In certain cases the possibility of doing away with these starters will be a sufficient inducement to erect a special REG dynamo.

If the latter is run as motor with separate excitation it will consume a practically constant current independent of the main voltage. As motor for an Ilgner fly-wheel set, for instance, it would take up a nearly constant current or nearly constant power without a slip regulator. The effect obtained by using an REG machine as motor can also be obtained by feeding an ordinary motor by a REG dynamo, the latter running either as generator or booster. Whether such an arrangement is justified from the economical point of view must be determined for each.

The above described dynamo has found extensive application for the lighting of railway cars during the last two years. In most cases the dynamos are driven from the car axle by means of belts. They do not require a reversing switch for changing the direction of rotation. The polarity of the main brushes is independent of the direction of rotation, since the secondary field producing the voltage between the main brushes reverses itself with changing direction of rotation.

A switch is inserted between the battery and the dynamo in order to connect up the dynamo after it has reached the battery voltage and to disconnect it before the train stops when a small back current begins to flow through the dynamo. With the sets built by the Gesellschaft für Elektrische Zubeleuchtunge in Berlin either an electromagnetic switch or an aluminum cell is used, the latter allowing, as is known, the current to pass through in one direction only. Both arrangements have been successful.

The very favorable experiences which have been made with this system on German and other railway lines have proved that the elimination of complicated regulating mechanisms and reversing switches increases materially the reliability of action.

According to the requirements of the various European railway companies a number of types of train lighting dynamos have been built for different outputs; some of these dynamos serve for the lighting of single cars, others for the lighting of whole railway trains. Fig. 16 gives a view of a 9-kw dynamo, which supplies current for lighting a whole train, being fixed on slide rails in the interior of the baggage car.

At present there are in actual work 170 of these dynamos, lighting in all about 600 cars. Among these are 23 dynamos for the Bavarian State Railways, of which the first were placed in service in August, 1904, the others were ordered after one year's satisfactory running; 52 dynamos for the Compagnie de Chemin de Fer d'Anatolie since the beginning of 1905; 20 machines for the Prussian State Railways since 1905; there are also complete sets in use at the Saxonion State Railways, the German Imperial Post, the Würtemberg Railway, the Compagnie de Chemin de Fer Paris-Orleans and at some other railways.

Water Power Electrical Development in the Carolinas.

BY J. C. PATTON.

Following a recent increase in the capital stock of the Southern Power Company, of Charlotte, N. C., from $7,500,000 to $10,000,000, plans for immediate developments which will involve an expenditure of over $3,000,000, and which will give the company approximately 100,000 hp, have been announced. These plans include the development of the company's power site at Ninety-Nine Islands, on the Broad River, six miles south of Blacksburg, S. C., and the other at Rocky Creek, two miles below the Great Falls station, on the Catawba River. At Ninety-Nine Islands the development will produce 16,000 hp, and that at Rocky Creek will produce 30,000 hp.

Plans and specifications for the work at Ninety-Nine Islands have already been made and some of the contracts for machinery will be let within a month. The building of the tenement houses for workmen and the clearing away of the lands will begin immediately. The power generated at this plant will go to supply the needs of mills in the adjacent cities.

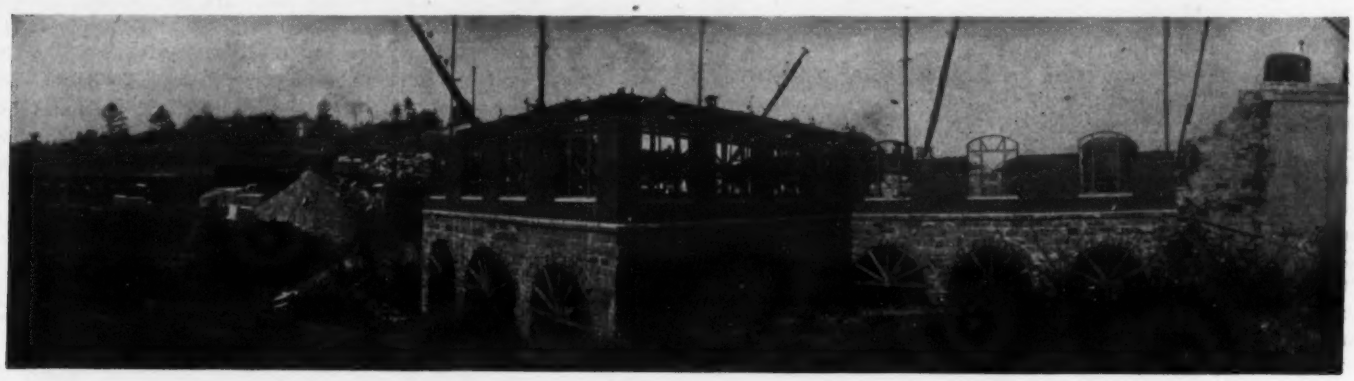
The work on the Rocky Creek power has already commenced. A quantity of material has been removed from the Great Falls station and storehouses, tenement houses, etc., are being built, while the stream is being cleared and preparation for the actual development is well under way. Transmission lines will connect this station with the Great Falls station, two miles above, and the electricity will be transmitted to the distributing center at the Catawba station, near Rock Hill, S. C., from which power will be supplied the mills in Chester, S. C.; Lancaster, S. C.; Union, S. C., and elsewhere in the territory where needed.

The Southern Power Company now has the largest capital of

DAM, HEADGATES AND SPILLWAY, GREAT FALLS STATION.

any having headquarters in Charlotte. It owns all the water rights for 110 miles along the Catawba River and controls the following named power sites: At the Catawba Falls, near Rock Hill, S. C.; at Mountain Island, near Charlotte; at the Lookout Shoals, near Newton, S. C.; at the Horseford Shoals, near Hickory, N. C.; at Landsford, near Lancaster, S. C.; at the Ninety-Nine Islands, near Blacksburg, S. C.; at Great Falls, near Fort Long, S. C., and the Wateree power near Camden, S. C.

The 150,000 of electrical horse-power which will be generated at these different points will be transmitted to cover a territory 150 miles in length and 100 miles in width. This territory stretches from Taylorsville, N. C., on the north, to Columbia, S. C., on the south, and from Greenville, S. C., on the west, to Darlington, S. C., on the east. A great number of cotton mills and manufacturing plants of all kinds are located in this territory, to all of which this power will soon be available.



Great Falls Hydro-Electric Station of the Southern Power Company.

The Catawba Falls plant, near Rock Hill, S. C., was the first finished by this company. Its 7,500 kw of electrical power was disposed of very shortly after it was placed on the market. To meet the urgent demands for more power the big development at Great Falls, ten miles below Fort Lawn, S. C., was then begun. Work at this station is being pushed forward with all possible haste and its 30,000 kw of electrical power will be available early in January, next. Between fifteen and twenty thousand horse-power, or about one-half of this supply, has already been sold and negotiations are pending for the remainder. It is the belief of the officers of the company that the entire output from this station will be sold before a single wheel turns.

By the beginning of next year it is probable that there will be little power available from present developments and it is in anticipation of this condition that the above extensive works have been started. When work was commenced on the Great Falls station last year a portion of the power generated there was intended to be transmitted to the mills about Gaffney, Blacksburg, Spartanburg and Greenville, S. C., but the demand from the mills about Rock Hill, S. C.; Gastonia, N. C., and Charlotte were so insistent that practically all the power was disposed of there. Consequently in order to satisfy the demands of the mills about Spartanburg, Gaffney and Greenville, S. C., the development of the power at the Ninety-Nine Islands became necessary.

In the Great Falls station, which is now rapidly approaching completion, there will be eight 3,000-kw, three-phase, 2,200-volt Westinghouse generators direct-connected to six horizontal turbines of the Escher-Wyss pattern and two Hercules turbines. The 400-kw, 250-volt exciters will each be capable of supplying the total exciting current.

It is planned so that two generators and their three transformers will form a complete unit, which if necessary can be entirely separated electrically from the other units. All the transformers will be mounted on trucks and in separate compartments and both the high and low-tension switch structures will be in separate rooms.

In order that the operator may see all meters without moving, the instrument pedestals to control stands will be arranged in a semicircle. A bench board was not considered advisable. The main transmission line will connect this plant with the Catawba station at Rock Hill, S. C., where a transformer station is being built to step up the voltage of the Catawba plant from 11,000 to 22,000, and to step down that of the main transmission line to 22,000 to feed the Charlotte division. Steel towers are being used in all main lines of transmission. They carry two three-phase circuits of No. 3-0 seven-strand hard-drawn copper, and have two grounded wires above the transmission cable. Besides this lightning protection both horn and water arresters are used. Transformers for sub-stations are built under standard specifications so that in case of breakdown a new transformer can be quickly substituted for a damaged one.

To arrange for the variation of voltage necessary for a station that might be feeding into an immediate neighborhood and feeding into a system sixty miles distant a few hours later, the generators, transformers and complete electrical apparatus are designed to carry continuously a 15 per cent increase in voltage.

In consideration of the country to be covered it is desirable to have the transmission voltage as high as practicable. Against this is the fact that the larger part of this power will be tapped off at a great many cotton mill sub-stations, having a capacity of from 250 to 750 hp. After calculating the copper loss for an assumed distribution, 44,000 volts was decided upon as best suited for this system. This works in well with the pressure of the Catawba station, which is 11,000 and the installed transformers on the Charlotte line, which are wound for 11,000 and 22,000 volts.

A contract has just been closed with the Cannon Mills, of Concord, N. C., by which the latter agrees to take 5,000 electrical hp, of which amount 4,500 hp will be furnished in the early part of next year. The cost of this power for the Cannon mills will approximate $75,000 to $100,000 annually. Among other southern power developments are those at Anderson, S. C., and Fayetteville, N. C. Mr. S. A. McCullough, of New York, representing the parties who recently purchased the property of the Cape Fear Power Company, near Fayetteville, N. C., states that it will be several months before the plant is completed and the power sent to Fayetteville. He estimates that it will take $100,000 to develop 1,500 hp and $150,000 to develop 4,000 hp nine months in the year. The power line of the Savannah River Power Company, from Gregg Shoals, is expected to reach Anderson, S. C., within a week. This line is twenty miles long. This company will also construct lines from its plant at Gregg Shoals to Greenwood, S. C., and Abbeville, S. C.

Recent Electrochemical Developments.

FERRO-SILICON FROM CARBORUNDUM.

Carborundum is carbon silicide (CSi) and is produced, as is well known, in the electric furnace by the process invented by Acheson from a mixture of carbon and silic sand with salt as a flux. It was later found that, according to the temperature used, different products are obtained by heating a mixture of carbon and silica. The product which one would expect *a priori* to be obtained first—namely metallic silicon (in an analagous way, as the reduction of other metals from their oxides by means of carbon)—is one of the most difficult to produce, and this problem has only recently been solved. In this connection Mr. F. J. Tone, of the Carborundum Company, has distinguished himself by inventing a furnace for the production of metallic silicon. The difficulty is that the temperature of reduction is

very close to the temperature of volatilization. It is therefore evident that the electric furnace must be so designed as to permit very close regulation of temperature. Mr. Tone has devised for this purpose a special type of resistance furnace which is now in commercial operation at the works of the Carborundum Company, and one of the chief problems in connection with metallic silicon is now to find a market for it.

Of course metallic silicon may be used to some extent in the steel industry as a substitute for ferro-silicon, but for some purposes the relatively low specific gravity of pure metallic silicon is a disadvantage, so that for most purposes in the steel industry ferro-silicons are preferred. Carborundum, which is used, of course, mostly as an abrasive, has been tried before as a substitute for ferro-silicon in the manufacture of steel. The evident advantage is that the commercial material contains some 62 per cent silicon, which is more than the content of silicon in ferro-silicons made in the blast furnace, but carborundum has two distinct advantages for steel manufacture. One is that it contains some 30 per cent of carbon, which is of course not wanted in the steel; the other is that at the temperatures ordinarily used in the manufacture of steel, the bath will absorb only limited quantities of silicon from carborundum. In view of these facts an indirect use of carborundum for steel manufacture suggested itself, namely, as a starting material for making ferro-silicon.

This problem has now been solved as described in a patent recently granted to Mr. F. J. Tone. When heated to a high temperature in an electric furnace, a mixture of iron and carborundum reacts in such a way that the silicon alloys with the iron while the carbon is thrown out as graphite. Now this carbon may be utilized for the production of further amounts of ferro-silicon. For this purpose the carbon is employed as a reducing agent for silica and iron oxides. The charge then consists of iron, carborundum, silica and iron oxide, and the products of reaction are ferro-silicon and carbon dioxide, which is set free.

Almost all the large quantities of high-grade ferro-silicon which have been used in recent years in the steel industry were imported from Europe, but the electric furnace ferro-silicon industry seems now to have become firmly established in this country. It is reported that the Wilson Aluminum Company has recently produced ferro-silicon intermittently, that is at times when they were not making ferro-chrome. Another ferro-silicon plant is stated to have been established in Pennsylvania. The process of Mr. Tone, which will undoubtedly be taken up by the Carborundum Company, marks another step in this industrial development.

INDUCTION FURNACE FOR ELECTROLYSIS OF FUSED ELECTROLYTES.

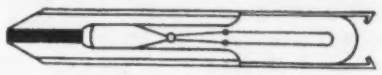
Dr. Leonard Waldo, who has been connected with the development of the Colby electric induction furnace (which is now in successful use in at least one plant in this country, namely in a plant near Philadelphia, for making "crucible" steel) has devised the idea of using the induction furnace for electrolysis of molten baths. For this purpose he simply inserts two electrodes at opposite points of the annular secondary of the induction furnace. Through these electrodes only as much electrical power is introduced as is required for electrolytic decomposition. On the other hand, the power required for heating the bath is entirely derived from induction from the current supplied to the primary of the induction furnace. It is of course not necessary to continually supply current to the primary, so that the primary circuit may be closed only long enough to keep the bath in a state of fluidity.

The advantage which Dr. Waldo claims for the process is that the electrolyzing current and the heating current may be regulated separately and independently of one another. This may be an advantage for certain work. On the other hand, this method of heating the bath will be found more expensive. Electric heating is in any event very expensive, but by introducing the current into the bath through electrodes and thus utilizing its joulean effect, practically the total electrical power is changed into heat. If, however, the power is introduced into the bath by induction, the efficiency will hardly be higher than about 50 per cent in most cases of practice.

New Telephone Patents.

SWITCHBOARD LAMP.

To any one who has struggled with the usual lamp puller and a refractory switchboard lamp, any improvement along this line will be of particular interest. Ordinarily a spring socket of slightly smaller normal bore than the diameter of the switchboard lamp is forced over the the latter, and the friction depended upon to extract it from its socket. This arrangement is crude and leads one into many difficulties. In Fig. 2 is shown a lamp designed to overcome this. It will be seen that the lamp terminals are extended to form a hook for extracting a lamp. J. L. Wright, of Washington, D. C., has made and patented this clever invention, and he has assigned his patent to the National Engineering Corporation.



WRIGHT SWITCHBOARD LAMP.

CALL REGISTER.

Now that prepayment coin collectors are used quite extensively there arises a need of a registering device which operates upon the same system save the depositing of the coin. Such a device is needed where the subscriber pays by the call and yet pays for accumulated calls rather than for individual calls. With the prepayment coin collector, a coin must be deposited before the exchange can be signaled. The operator may then at will return or deposit the coin according to whether the call is or is not completed. With such a station meter a push button is depressed to begin a count, the button becoming locked, under the control of an electromagnet. If the call is completed, a special current applied on one side of the line releases the button and counts one. If the call fails, current on the other line limb releases the button without counting. In order that there may be no doubt as to the count, F. R. McBerty has provided a tell-tale signal in his circuit. This consists of a lamp controlled by a relay, and by the operator's collector keys. Thus, when the operator proceeds to restore the subscriber's push, or to count, a lamp lights as long as the key is held, provided the subscriber's push is set. If the latter be restored, there is no lighting of the lamp. The operator can, therefore, test the counter action by a double operation of her key; the first lights the lamp, the counter being set, and the second does not light the lamp, if the push has been restored. Mr. McBerty has patented this device and has assigned his patent to the Western Electric Company.

STATION APPARATUS.

R. D. Manson, of Elyria, Ohio, has designed a receiver of the bipolar hand type, the improvement lying in the details of structure. The whole magnet system is carried upon a metallic cup which also supports the diaphragm. The cup is perforated to break up resonance effects. The permanent magnet consists of two bar magnets and a yoke bolted to the pole extensions and a spacer. This spacer carries also the cord tip clamps of novel and neat design. Extensions from the clamp pass through clearance perforations in the cup and serve as terminals of the coil windings, in close proximity to the spools. The patent for this receiver is assigned to the Dean Electric Company.

All metal bell boxes seem to be becoming a prevailing fad. A patent for the details of such a subscriber's set has been granted to J. A. Birsfield, of Rochester, N. Y., and assigned by him to the Stromberg-Carlson Company.

A subscriber's set of the desk-arm variety forms the subject of a patent obtained by S. C. Houghton. The arm proper consists of two bars and two heads set up together as a parallel motion capable of moving in a vertical plane. The front head carries the transmitter and hook switch. The cords pass through one of the bars, these being hollow. The second head is held by the base plate, but is capable of rotation about a vertical axis. The bars have a telescope joint so as to be capable of longitudinal extension. The result is an arm capable of complete adjustment. The Wire and Telephone Company of America has been assigned the patent.

The trouble from receivers not being hung up has led H. E. Smith, of Norwich, N. Y., to devise an automatic receiver return. A cord reel is arranged with a coil spring sufficiently strong to lift the receiver in winding up the cord. The hook switch contacts are controlled by a lever having an eye through which the coil is led. If the receiver be released the cord is wound, the receiver striking the lever and shifting the switch contacts.

F. F. Howe, of Cleveland, Ohio, has patented a receiver support with the usual arms, levers and adjustments. The complication will doubtless offset its utility.

A self-contained audiphone for the deaf has been patented by E. W. Schneider, of New York City, in which the battery case and transmitter are fastened together so that the one serves as a handle for the other. A single two-conductor cord between the transmitter and receiver cases thus suffices for the instrument.

TRUNKING CIRCUIT.

Messrs. J. W. Latty and C. L. Goodman, of Philadelphia, have devised a trunk circuit with a positive disconnect signal controlled by the originating or A operator, and with complete supervision at the A end. Thus, the supervisory signals at the originating end respond respectively to the calling subscriber and to the subscriber of the distant exchange. This, of course, is quite common practice, the only novelty lying in the special details of circuit.

LINE SIGNAL RELAY.

A peculiar line signal relay for lamp magneto switchboards has been patented by H. P. Clausen, of Chicago. The relay is somewhat of the nature of a self-restoring drop, having an armature at each end, and two distinct coils. One armature serves as a latch under a lever secured to the other armature. When the first armature is pulled up the lever falls, closing a contact. When the second coil is energized it attracts its armature, breaks the contact, lifts the lever which becomes latched by the first armature falling back. The patent for this relay has been assigned to the American Electric Telephone Company.

IMPROVED APPARATUS.

A telephone spring clip for test sets forms the subject of a patent granted to G. L. Rosenberger, of Manassas, Va. This is an elaboration of the usual suspender clip, the prongs being elongated and slotted for different sized wires.

J. A. Wotton has patented the details of construction of a switch hook lever. This is pressed out of a single piece, the prongs being formed out from the end which is slotted to permit of forming. The Electric Manufacturing & Equipment Company has been assigned this patent.

A hook switch to indicate the number of each station coming in on a busy line has been invented by D. Howard, of Binghamton, N. Y. The hook lever carries a toothed sector over which a spring trails. The number of teeth indicates the station coming in on the line.

TRANSMITTERS.

H. A. Cutmore, of London, England, has invented a special form of mouthpiece for transmitters. The speaking end is of flexible material to conform itself under pressure to the face of the speaker. Below this is a double cone on end, meeting the forward mouthpiece and one end entering the transmitter. Within the double cone is a diaphragm at the widest section on which is mounted a solid cone with its apex toward the entering sound. A gauze diaphragm at each end of the double cone and several rings of small perforations through the walls of the mouthpiece completes the arrangement.

COMPOSITE SYSTEM.

With the increased use of combined telephone and telegraph systems for railway working, composite systems are of constantly increasing value and importance. With almost all such systems the practiced ear can detect at the telephone the "thump" of the Morse currents. With a view to reducing this, H. O. Rugh has patented a system having a low-resistance, high-inductance shunt bridged across the telephone receiving appliances. The low-resistance path acts as a shunt to the telephone receiver for low-frequency telegraph currents, while practically of no effect for the telegraph currents. The Western Telegraphone Company has been assigned this patent.

Letters to the Editor.

Wireless Working in Daylight.

To the Editors of Electrical World:

Sirs:—In your issue of July 28 there is a paragraph on wireless in daylight which states that trouble has been experienced in working the wireless system between Nome and St. Michael, and that this trouble was coincident with the beginning of the long days. While this statement is substantially correct, I wish to call attention to the fact that the increase in daylight is very gradual and that on but three days was there any disturbance. This disturbance occurred between one and half-past 3 o'clock on each of these days and affected both stations equally.

From the fact that this effect occurred during but three days, and that these three days were consecutive, it would seem probable that ionization due to the sun's rays was not the cause. This partial interruption during three days is the only interruption to this system since August, 1904.

Fort Omaha, Neb. Leonard D. Wildman,
Captain, Signal Corps, U.S.A

Austin Thermo-Electric Wave Detector.

To the Editors of Electrical World:

Sirs:—In 1905 Dr. L. W. Austin kindly consented to investigate some matters connected with electromagnetic wave phenomena for the National Electric Signaling Company. During the course of these investigations Dr. Austin discovered the important fact that very sensitive wave detectors, more sensitive and reliable by far than any coherer and more sensitive even than the magnetic receiver, could be constructed by using thermo-electric elements without a local battery, provided the conductors were brought into contact with sufficiently great pressure. This latter condition is very important and probably accounts for the fact that prior to Dr. Austin's work no one seems to have discovered the fact that sensitive wave detectors could be made in this manner, and that the local battery could be entirely done away with.

In accordance with the terms of his agreement with the National Signaling Company, Dr. Austin applies for a patent for this form of device and assigned his rights to the same to us. As the application has now been filed for a sufficient length of time we make the present announcement. It is to be hoped that Dr. Austin will later publish a complete description of his invention.

Washington, D. C. Reginald A. Fessenden.

Trouble from Wireless Stations.

To the Editors of Electrical World:

Sirs:—The article in your issue of October 27 (page 793) entitled "Trouble Caused by a Wireless Station" recalls an experience of the writer somewhat similar though different in details.

The station was supplied by an independent alternator giving about ten times the power used in the case cited. Direct current was used for lighting and power purposes in the building, both supplied from a distance which necessitated the transmission lines to parallel each other and those of several other circuits. Furthermore, the station being of large capacity, used a wide spread of antenna, and in its experimental stage was erected irrespective of neighboring circuits of telegraph, telephone and low potential alternating currents.

It was a common occurrence at first for fuses to blow in the direct-current circuit; motor field-coils were burned out, and the life of incandescent lamps was rendered very short. Telegraph instruments on the line near the station were also burned out, but telephones remained intact. The telephone circuit was of the single-conductor grounded type. A partial remedy for the trouble was found by grounding the lines affected so far as possible through condensers at many points. Low-potential lightning ar-

resters were also used advantageously, and no more serious trouble was experienced. Small fires were started at times by the rush of current following the breaking down of insulation in lamp sockets or at fuses, but only in one instance was serious trouble caused outside of the building containing the apparatus. This was a fire started on account of the very poor insulation and installation of wire in a house using alternating current from a line running near the antenna. For many hundred feet away from the station a person could draw static sparks from wires insulated from ground, but at the distance of 100 ft. these sparks had not power enough to be felt.

This station used a comparatively long wave, with large capacity and small inductance. When, however, the inductance was increased to any extent, the effect on neighboring circuits and conductors was greatly augmented. These effects were produced partly through direct leakage and ordinary induction from the paralleling lines, and partly by induction from the antenna.

ALBANY, N. Y. JAS. L. ROBINSON.

Resonance in Wireless Telegraphy.

To the Editors of Electrical World:

SIRS:—In the rapidly progressive art of wireless telegraphy a divergence of nomenclature exists as to what is implied by a "resonant circuit." I proceed to quote a few passages showing this divergence with the view of suggesting that an authoritative definition of the term is desirable.

An electric circuit of which the discharge is oscillatory will be set in oscillation by electric impulses of the same period. If, however, two electric circuits are closely connected together by mutual induction as a system they are found to have oscillations of two distinct periods. Unless one of these oscillations is suppressed so as to be inconsiderable in relation to the other, the compound circuit is not serviceable for selective telegraphy.

Now should the word "resonant" be used for a circuit in which the oscillations produced are of a single type to the exclusion of those of any other period, or should the word "resonant" be used for any circuit which can be thrown into oscillation?

Heaviside says (*Electrical Papers*, Vol. II, 195-196):

"The distant end impedance may easily be less than the impedance according to the magnetic reckoning. What is more remarkable, however, is that it may be much less than the steady resistance of the line. This is due to the to-and-fro reflection of the dielectric waves which is a phenomenon similar to resonance."

Webser says (*Electricity and Magnetism*, page 500):

"This is the case of the so-called resonance, though not the one we have examined. We see that one of the periods is greater, the other less than the common period of the separate circuits."

Max Wien (*Ann. der Physik*, Vol. 8, page 686, February, 1902), comes to the conclusion that the ratio of the square of the mutual inductance between the two circuits to the product of the self-inductance of the two circuits must be small as compared to unity if a circuit is to be thrown into oscillations of a unique period by waves of a unique period, and thus the coefficient of coupling must be small; and, again (*Ann. der Physik*, Band., 14, 1904): "If we presuppose equal vibration periods and equally strong excitation, with close coupling a far-reaching range of signaling is possible but no resonance. This can only be attained by very loose coupling at the cost of the strength of the emitted waves so that telegraphy in this way is only possible over relatively small distances."

Drude, *Ann. der Physik*, 13, says with reference to a strongly coupled receiver that "theoretically only by very close coupling in the transmitter $K' > 0.6$ can the receiver be tuned to the transmitter. The frequency of the receiver must be smaller than the frequency of the two transmitter circuits (each tuned to the same period)." He expressly states that he has, up to the present date, no experimental proof of this theoretical possibility.

However that may be, the words "good resonance" are used by Drude as implying an oscillation of a single period in the receiver.

In patent 714,756, to Stone, the following passages show a decided limitation of the word resonance:

"Since a coil constructed in the usual way behaves for high frequencies as a conductor having distributed resistance, inductance and capacity it follows that such a coil will show for high frequencies the same quasi resonance as is observed in long aerial lines and cables; i. e., that it will *per se* and without the intermediary of a condenser show a slight degree of selectivity for some particular frequency and for certain multiples of that frequency just as a stretched string which has distributed inertia and elasticity will respond to the particular tone called its 'fundamental' and to all other tones whose periods are aliquot parts of the periods of that fundamental; but it is not with such quasi resonance that the present system is carried into effect, and I wish it understood that I here disclaim any system employing distributed inductance and capacity as a means for tuning the resonant circuits described in this specification."

The question that these quotations suggest is whether "resonance" and "resonant circuit" shall be confined to a special form of circuits, namely, that in which only oscillations of one period are produced by an exciting train of waves; or shall the word "resonant" be used in a broad sense as denoting "capable of being thrown in oscillation" and some such expression as "selectively resonant" used for circuits which respond to the oscillations to which they are tuned in such a way as give a wave of one unique period only?

WASHINGTON, D. C. C. H. HINTON.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Design of Electrical Machines.—ZIEHL.—A paper read before the Berlin Electrical Society on modern tendencies in the construction of electrical machinery. The chief tendency is that of standardization. The author considers the ordinary polyphase induction motor to be the simplest and most ideal of electrical motors. He has, therefore, endeavored to derive an analagous design for all other kinds of rotating electrical machinery, specially direct-current machines. In the latter case this principle leads to the compensated direct-current machines of the Deri or Ryan system. In carrying out this principle the company with which the author is connected uses the same construction of frames, bearings, etc., for all kinds of machines, whether alternating or direct-current machines or converters. Special attention has been paid by the author to the construction of the stator so as to get a large radiating surface to provide a good cooling effect. The advantages of standardization are pointed out In a discussion in which Rosenberg, Dettmar, Eichberg and the author participated, the question was brought up whether the new interpole machine does not accomplish the same as the Deri compensated machine and at the same time is cheaper. The opinions concerning this point differed. It was also questioned whether such a complete standardization of all different kinds of machinery as attempted by the author was really practical.—*Elek. Zeit.*, October 11.

Brushes.—MOLNAR.—An article giving notes on commutator brushes. A good dynamo-brush should have very little resistance in the longitudinal direction in which the current flows, in order to reduce the ohmic losses. On the other hand in the transverse direction, tangential to the commutator, the resistance should be as high as possible, since in this direction the short-circuit currents tend to flow, which are the real cause of sparking. A high transversal resistance in comparison to the longitudinal is therefore preferable for good commutation. Some notes are given

on the manufacture of carbon brushes, and the absolute necessity is pointed out of always using brushes of the same longitudinal resistance and of the same type on one and the same machine. The mechanical pressure of carbon brushes on the commutator is normally from 0.1 to 0.15 kilogram per square centimeter, but must be higher for machines which are subjected to strong vibrations, like tramway motors. Experiments in the laboratory have shown that the minimum pressure at which cracks appear in carbon brushes is 4.2 kilograms per square centimeter. Too high a pressure causes large friction losses and large heating. If the pressure is too low the vibrations of the machine may easily produce sparks. The transition resistance between brush and commutator is high with hard brushes which are poor conductors, and low with soft brushes which are good conductors. High transition resistance is advantageous for good commutation, but it causes higher heat losses and greater heating of the commutator. Hard carbon brushes with a high transition resistance are preferably used with high-voltage machines where there is less danger of overheating of the commutator than with low-voltage machines. For the latter, soft brushes with a low transition resistance are used. The temperature coefficient of the transition resistance is negative like that of carbon. The transition resistance, therefore, decreases with increasing current density. It is peculiar that the transition resistance depends on the direction of the current; i. e., it is different whether the current flows from carbon to metal or from metal to carbon. For this reason sparks appear sometimes earlier at the negative brushes of a dynamo than at the positive brushes. The transition resistance is approximately inversely proportional to the current density. The voltage drop per brush is 1.2 and 1.5 volts for very hard carbon brushes, 1.1 to 1.2 for hard brushes, 0.7 to 1. for soft brushes, 0.45 to 0.60 for very soft brushes. As an average 1 volt may be taken. The tendency of making brushes with a greater transversal resistance than longitudinal resistance, led to the simultaneous use of metal and carbon. Fig. 1 shows a simple type of such a combined brush, which consists of two separate brushes, *A* being of metal, and *B* of carbon. The useful current is carried almost entirely by the metal brush while towards the end of the commutating process the carbon brush increases the resistance of the short-circuit and therefore decreases the short-circuit current. Such combined brushes are useful for low voltages and large currents, but need careful attention. Combined brushes consisting of thin carbon layers with interposed metal sheets or gauzes are simpler, but the author thinks pure carbon brushes consisting of two or more thin carbon brushes of different conductivity have better prospects. They are pasted together to form one single brush. Some notes are given on the "morganite" graphite brush made by an English company.—*Elek. u. Masch.*, October 21.

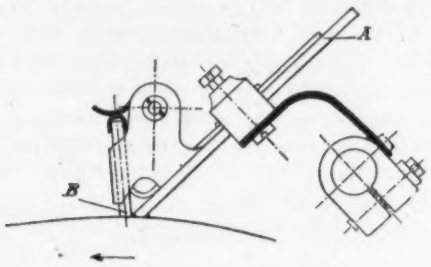


FIG. 1.—BRUSH.

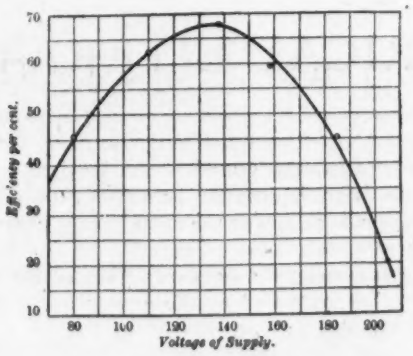


FIG. 2.—EFFICIENCY CURVE.

Rectifiers.—Jolley.—An article in which the author first gives some notes on tests of a permutator, i. e., a machine in which the rectified current is collected from a stationary commutator by synchronously rotating brushes which are automatically started and run up to synchronism by simply closing the main switch. (See Electrical World, December 23, 1905, p. 1072.) In tests with such a permutator of 10-kw capacity very disappointing results were obtained when the machine was used for battery charging, but it was found that the behavior could be greatly improved by using an inductance in series with the battery. Under these conditions the performance as a whole can be made to compare with that of an equivalent synchronous converter. The author then describes some tests of a small electrolytic rectifier of the Nodon type. The full load efficiency was found to be above 70 per cent and the electrolytic rectifier was found to be able to give considerable overloads without great reduction of efficiency. The effect of temperature, however, is serious whenever the temperature of the electrolyte becomes about 40° C. The electrolytic rectifier is not thought to be suitable for incandescent lamps or constant-speed motors, etc., requiring close regulation, while it is eminently suitable for battery charging and for cases demanding constant-current supply. A test was made to study the electrolytic rectifier with varying voltages of supply. The voltage was changed by adjusting the exciting current of the alternator supplying the rectifier, whose direct-current load was maintained constant at 500 watts. Fig. 2 gives the relation between the voltage and full-load efficiency which reaches a maximum at 135 volts. At the higher voltages the rectifier heats very rapidly. Changes in efficiency have but little effect between the limits of 40 and 200 periods per second. The tendency is to lower the efficiency as the frequency rises.—Lond. *Elec.*, October 12.

Single-Phase Commutator Motors.—Bragstad and Smith.—The first part of an article in which the authors describe a point-by-point method for the determination of the characteristic curves of single-phase series commutator motors when both the saturation of the iron and the effect of the currents in the short-circuited sections are taken into account. The authors first discuss the effect of magnetic saturation, and then propose to deal with the effect of the currents in the armature coils short-circuited by the brushes, and to give an illustrative example. The article, which is illustrated by diagrams, is to be continued.—Lond. *Elec.*, October 12.

Break-Downs of Electrical Machinery.—A long abstract of the annual report of the British Engine, Boiler and Electrical Insurance Co. on insurance and inspection of electrical machines in 1905. During the past year there was a noticeable increase of break-downs of machinery, especially motors, and it is thought that the heavier fuses which the company has been compelled to allow to meet the heavy starting currents required by motors in many cases are not without influence on the rate of break-downs. While this rate is decreasing among dynamos, it is increasing among motors, particularly small motors. The rate among direct-current motors exceeded the rate among alternating-current motors by 40 per cent, while the rate among alternating-current dynamos exceeded the rate among direct-current dynamos by 29 per cent. Notes are given on some typical examples of break-downs.—Lond. *Elec.*, October 12.

Lamps and Lighting.

Lighting of Hospitals.—Zandt.—Some illustrated notes on the methods of lighting used in various surgical operating rooms of hospitals in Hamburg. In the older operating rooms of the Hamburg hospital an illumination of 170 lux (meter candles) at a height of one meter above the ground; that is, at the height of the operating tables, was obtained. This was accomplished by means of reflectors open at the bottom and provided with ten carbon-filament incandescent lamps, each at 32 cp. The lamps were not very much more than one meter above the operating table. A great disadvantage of this arrangement was the strong heating effect of the lamps, and also the fact that the reflector produced sharp shadows so that in certain surgical operations hand lamps had also to be used. In one of the newer hospitals

better results have been obtained with open direct-current arc lamps which can be moved so as to suit special requirements. While the illumination in lux is much less than that given above, this method was found to be greatly superior. In another hospital reflectors are used at a height of 3 meters above the operating table, each reflector containing 21 osmium lamps, each of 32 cp. To produce a more uniform distribution of light each reflector is closed at the bottom with a frosted glass disc. Under these conditions there is no trouble due to heating, and the osmium lamps are said to give a very pure white light. Details of the arrangement are given in diagrams.—*Elek. Zeit.*, October 11.

Power.

The Industrial Power Problem.—ESSON.—His presidential address to the (British) Civil and Mechanical Engineer's Society. The author gives, first, figures on the cost of energy in a factory which would have its own isolated plant on the premises with an output of 1,000,000 electrical hp-hours per year. The final figures of the author are given as follows, interest on the capital outlay and depreciation being assumed at 10 per cent per year:

	Mond Gas	Suction Gas	Steam Condensing	Steam Non-c'dens'g	Oil
Works cost	$0.452	$0.598	$0.510	$0.568	$0.560
Capital charges	0.322	0.248	0.260	0.236	0.328
Total cost	$0.774	$0.846	$0.770	$0.804	$0.888

From these figures it will be seen that when any considerable amount of power is required it can be produced on the consumers premises at a cost between 0.770 and 0.888 cent per electrical hp-hour, according to the plant employed. (These figures are criticised in an editorial where it is said that the cost of fuel for condensing steam plant, estimated as 0.18 cent per electrical hp-hour, is too low, and that most engineers would consider that steam plants in average working, condensing or non-condensing, cost more on a fuel basis than suction gas plants or Diesel oil engines, instead of the reverse. Buildings are not included in the figures and the final figures given above for the total cost of private generation include interest and depreciation combined at 10 per cent, but do not include any management charges, so that the above figures are in general too low.) The author then discusses the question whether electric stations which undertake to deliver electricity from a general power house could beat these figures. The author refers to the conditions existing in London where there are no less than 62 electricity supply works, the average capacity of each being below 4,000 hp. He points out that the outlay per electrical horsepower for a large modern power house could be reduced to about one-third of what now constitutes the average for the London supply stations. A supply station, when competing with an isolated plant located on the premises of the consumer has the great disadvantage of the cost of the distribution system. For a power house having a capacity of 20,000 hp the author thinks that unless the undertaking can secure an all-around price of about 1.25 cent per hp-hour, it will not pay the dividends it sets out to earn. In general it will pay a factory to generate its own electricity, considered from the purely investment point of view, but the margin is not large, and if the supply companies can come within reasonable distance of the price, they will be sure of securing a good number of large consumers. The reason is that to compete with the power companies, the equipment in the factory must be of the highest efficiency, and to get up-to-date equipment, the power user would have to spend considerable money. The author finally mentions the scheme that a large power house for the supply of energy to London should not be located in London at all, but that the energy should be transmitted to London from the coal fields. The fuel would be cheap slack, the proper place to use it at the pit's mouth, and the proper way to use it would be to gasify it in Mond gas producers, and then burn the producer gas in gas engines. An ammonia recovery plant would constitute part of the equipment. While this scheme is fascinating, the author is not prepared to say whether it would be commercially successful.—Lond. *Elec.*, October 12.

Suction Gas Locomobiles.—After the steam engine had come into extended use, the steam locomobile opened new fields of application on account of its transportability. From the transportable small steam locomobile there was developed later the stationary steam locomobile. The same development is now going on with suction gas plants. An ordinary suction gas plant has certain disadvantages compared with steam locomobiles, especially as the separate installation of the gas producer and the gas engine require more space, more attention, and greater

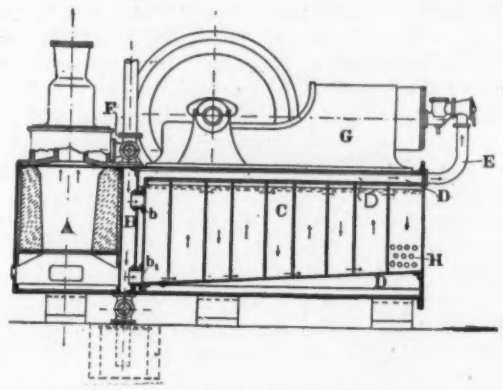


FIG. 3.—LOCOMOBILE.

expense for foundations, pipes, etc. To avoid these disadvantages, the suction gas locomobile was invented which has the advantage of very compact construction. The general construction of suction gas locomobiles of from 8 to 60 hp is shown in Fig. 3. The only piece of pipe line—between collector and gas engine—carries purified gas, and has a length of one-half to one meter. *A* is the gas-producer, *B* the dust-catcher, *b* and b^1 are openings through which the gas enters the cleaning chambers. The exit of the clean gas is at *H* into the collector, *E*. The pipe, *F*, then conducts the gas to the gas engine, *G*. As in ordinary suction gas plants, fuel is added every 5 to 10 hours. Coke, anthracite coal, peat, or lignite briquettes may be used as fuel. The consumption of cooling water is between 5 and 8 kilograms per hp-hour. The consumption of fuel is the same as in ordinary gas plants of the same size. On the other hand, the saving in space amounts to 35 per cent, the saving in cost of foundations 80 per cent, and in cost of erection to 70 per cent. Of essential importance are compactness of the construction, ease of attendance, exchangeability of different locomobiles, the possibility of using the locomobile at different places, and the absence of any pipes for carrying unclean gas.—*Elek. Zeit.*, September 13.

Swiss Water-Power Station.—BIGNAMI.—An illustrated description of a new hydro-electric station utilizing the falls of the Erlenbach. The power house is designed for six units of 2,000 hp each, but so far only four have been installed. The station supplies electric current for lamps and motors in the city of Lucerne, 16 miles distant, and about 400 kw for lamps and motors in smaller towns in the neighborhood. The conditions in Lucerne demanded the most perfect and regular lighting service obtainable, indicating the use of single-phase current. Two separate systems of bus-bars and two distinct services were therefore combined in the installation—single-phase current for the Lucerne lighting system, and three-phase for the rest. The four alternators are double-current generators, generating three-phase currents and single-phase current for motors and lamps, respectively.—*Eng. Mag.*, November.

Power Plant.—DIXON.—A continuation of his serial on the planning and construction of a power plant. In the present installment natural and mechanical draft are discussed.—*Eng. Mag.*, November.

Electric Winding.—VALBREUZE.—The first part of an illustrated description of various new electric winding installations in mines.—*L'Eclairage Elec.*, October 20.

Traction.

Single-Phase Traction.—A description of a new traction system with rectified single-phase current devices by Auvert and Ferrand. The system is proposed to be used on main lines of railways. It involves the employment of a special design of "regulating rectifier," which takes single-phase current from the line and supplies continuous current at varying voltages to the motors driving the train, its function being similar to the motor-generator of the Ward-Leonard system. The apparatus is somewhat similar

in principle to some forms of "permutator," and consists of a group of commutators connected to sections of a revolving ring winding, and driven by a synchronous motor. The arrangement differs from the usual form of permutator in that the commutators revolve and not the brushes, but, like the permutator, does not involve a driving motor capable of handling the total power, as the rotation is required only for collecting and not for inducing the transformed current. The apparatus is, therefore, considerably lighter than a motor-generator of corresponding output. The sections of the rotating winding may, roughly speaking, be compared to auto-transformers, the steps of which are so connected to the commutator segments that the alteration of the relative position of the two sets of brushes controls the mean voltage of the continuous-current side of the apparatus. Thus, all regulation of the voltage supplied to the motors driving the train, and consequently of the speed of the train, can be effected by shifting the brushes of the rectifier entirely without the use of rheostats. The resulting rectified current is, of course, pulsating, but the introduction of an impedance coil into the circuit to some extent improves its wave form. The system has not yet been tried under actual traction conditions, but the P. L. M. Railway has carried out a series of tests at its workshops in Paris, with a 400-kw set, consisting of two regulating rectifiers, each having two commutators with four lines of brushes. In order to approximate as nearly as possible to traction conditions, the load consisted of four series-wound traction motors which were belted to generators, so that their output could be easily measured. The rectifiers were geared together and driven by a small synchronous motor at 750 revolutions per minute, the input current being supplied from a single-phase transformer at 160 volts, 25 cycles. The voltage on the continuous-current side could be varied from 20 to about 250 volts and the overall efficiency of the converting system was found to be 93 per cent at the latter and 68 per cent at the former voltage. Some further tests have been carried out at the Alioth Company's works near Basle, where the reversibility of the apparatus was demonstrated, indicating not only the possibility of regenerative braking but the use through the medium of similar appliances of substation batteries on single-phase currents. In neither of these tests was the slightest trouble experienced with sparking.—From *Bull. Ass. Ing. Elec. Inst. Elec. Montefiore,* abstracted in Lond. *Elec.,* October 12.

Installations, Systems and Appliances.

Load Factor of Electric Power Stations.—Norberg-Schultz.—An article on the variation of the load of a water power station at which at present 6,000 hp are developed and which supplies three-phase currents to places near Christiania, Norway, mainly for power purposes. The total connections amount to 69 motors requiring 27,500 hp. and 3,146 incandescent lamps corresponding to 150 kw, and 8 arc lamps corresponding to 3 kw. The maximum load of the year from July, 1904, to June, 1905, occurred in March, 1905, and was 1,338 kilovolt-amperes. On the assumption that the power factor was .85, the maximum load would have been 1,150 kw. The total load factor, relating to this maximum load, was about .45, which is much higher than in lighting stations. In the electric lighting station of Christiania the maximum load of the year was 2,000 kw, and since the annual generation of energy was 3,355,000 kw-hours, the load factor was .19. If the two plants for power and for lighting had been combined and operated together, the maximum load during the year would have been only 2,813 (since the maxima in both stations are not coincident) and the load factor 32. In general, if a lighting station and a power station are combined, the maximum load will be less than the sum of the maximum loads of the two stations. In the present case the maximum load of the combined stations would equal the maximum load of the lighting station plus .70 of the maximum load of the power station alone. Some figures are then given on the advantages resulting from adding a traction load to a combined lighting and power station. If the lighting station alone has a maximum load of 2,000 kw, the power station 1,150, and the traction station (in this case, the tramways of Christiania) one of 1,118 kw (the sum of these three figures being 4,268 kw), the total maximum load would have been only 3,187 kw. The article is illustrated by various load curves and diagrams.—*Elek. Zeit.,* September 13.

Birmingham.—The first part of a detailed illustrated description of the new Summer-Lane generating station of the municipal electricity works of Birmingham. Four classes of supply are dealt with, as follows: (1) A direct-current supply for lighting and private power purposes in the neighborhood of the station at a pressure of 220 and 440 volts. (2) A direct-current supply through a system of trunk mains, to the distributing switchboards at Dale End and Water Street generating stations at a pressure of 440 volts, in order to deal with the increase in the demand for private lighting and power supply. (3) A direct-current supply to the tramway system within a radius of about 2 miles from the generating station at 550 volts. (4) A high-pressure, three-phase supply to the sub-stations which have been erected in the outlying districts, at a pressure of 5,000 volts. Accommodation has therefore been provided in the engine room for direct-current plant to the extent of 13,000 kw, of which 7,000 kw for direct current and 4,500 kw for alternating current form the capacities of the first equipment. In the engine room there are two rows of generating sets on either side, the direct-current plant being on one side and entirely separated from the alternating-current plant on the other side. There are two 500-kw turbo-generators, but the greater part of the sets are driven by reciprocating engines. The chief point of interest in the direct-current machines is their size and the large number of poles necessitated by the comparatively slow speed of 160 r.p.m. Each machine has 16 poles cast into the frame, and is rated at 1,500 kw with an overload capacity of .25. They are compound wound for 550 volts on the traction load and can also be used as shunt machines for lighting at 460 to 520 volts.—Lond. *Elec.,* October 12.

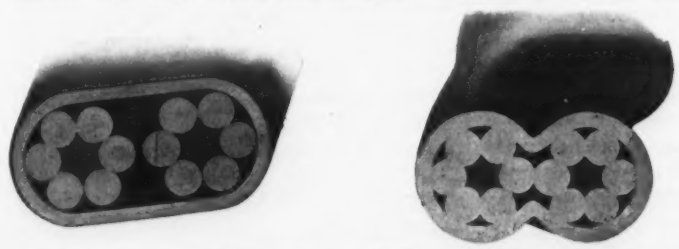
Converting from Steam to Electric Traction.—An illustrated description of the way in which the old coaches of the Metropolitan Railway in London installed for steam traction were converted for use with electric traction.—Lond. *Elec.,* October 12.

Clamp and Sleeves for Long Span Work.

The accompanying illustrations show some useful devices for long-span electric transmission systems. The clamps are designed

FIG. 1.—CLARK CABLE CLAMP.

to grip firmly both the conductor and the insulator in such a manner that they cannot part company, and that the strain will



FIGS. 2 AND 3.—SPLICING SLEEVE BEFORE AND AFTER TWISTING.

be passed from the conductor to the porcelain without concentrating the pressure upon a small area of the porcelain. They are intended for both the standard types of insulators and some

special types where both the insulator and the clamp are designed to fit together and grip the cable within the body of the porcelain instead of around the neck.

The splicing sleeves are designed to establish a close electrical and mechanical contact in connecting the ends of transmission cables, without heating and thereby annealing the wires. The connecting sleeves are made up with a hard exterior and a soft interior so that when a joint is made the sleeve is drawn down firmly around the wires and the wires are partially imbedded in the soft inner wall and as the surfaces in contact are both of pure copper, they are not effected by expansion and contraction and the conductivity remains unaffected.

These devices are made by the Clark Electric & Manufacturing Company, 135 Broadway, N. Y.

An Electric Recording Pyrometer.

In this era of rapid technical progress in all industrial and manufacturing establishments where high temperatures are employed there is an increasing demand for instruments to record automatically and accurately every change that occurs. Records obtained from such apparatus make it possible to control the temperatures so that the product is perfectly uniform and most economically produced.

The recording pyrometer herein described is of the thermo-electric type, which is capable of application to almost every commercial and industrial requirement.

A complete instrument consists of the following parts: (1) The recorder, which is located at the point most convenient for observation of the records and for changing of the charts. (2) The thermo-electric couple, the fire-end of which is to be inserted into the space where the temperature is to be measured. (3) The leads consisting of duplex flexible cable, for making the electric connection between the recorder and the fire-ends.

The current of electricity produced by the thermo-electric couple, which is located where the temperature is to be measured, actuates a galvanometer movement which is contained in the dust-proof metal case shown at upper portion of Fig. 1. The galvanometer movement is made according to a special design with pivot and jewel bearings for the moving coil. It is "dead-beat" in its action.

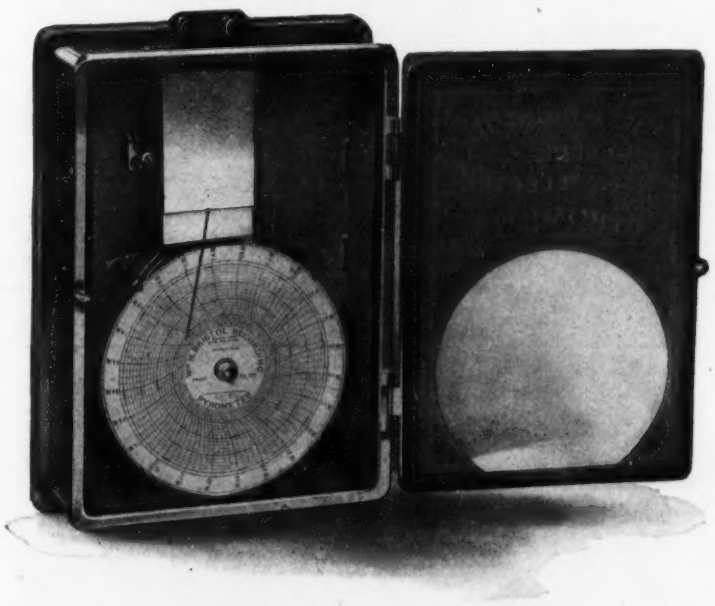


FIG. 1.—INTERIOR VIEW OF RECORDING PYROMETER.

The delicate recorder arm moves perfectly free and clear just in front of a chart which is revolved by a clock movement once in 24 hours or at any other desired rate.

The charts are prepared with a semi-transparent smoked surface, which is so sensitive that a record may be made upon it with a hair. The clock movement for revolving the chart is contained in a round case behind the chart and is provided with an auxiliary attachment for periodically vibrating an unsupported portion of the chart, thus bringing its smoked surface at intervals of a few seconds into contact with the pointed end of the recorder arm. The series of marks made by the periodic contact of the recorder arm where the carbon is removed from the chart forms a continuous curve unless the changes of temperatures are extremely rapid.

After the record of the day is completed the chart is removed from the instrument and "fixed" by immersion in a fixative solution. This solution consists of gasoline or alcohol to which has been added a small amount of concentrated fixative. After fixing, the charts may be handled and filed away without danger of destroying the record.

FIG. 2.—REPRODUCTION OF SMOKED CHART.

Fig. 2 is a reduced photographic reproduction of a smoked chart with a record of the temperature in a lead bath, which is used for calibrating these pyrometers. It is interesting to note the constancy of the temperature during the period of nearly half an hour while at night the mass of metal was cooling and passing from the molten to the solid state.

The simplicity of construction insures durability and permanent accuracy, and makes the operation of the instrument an easy matter. The protecting case containing the galvanometer is hinged to the back of the recorder, and can be turned to one side. This arrangement provides against danger of injury to the recorder arm while the charts are being changed and the clock wound. The thermo-couples employed for ranges not exceeding 2,000° F. are made of special alloys which are inexpensive and may be of almost any desired form or length to suit the special requirements. For ranges above 2,000° F. the standard Le Chatelier platinum and platinum rhodium elements are used.

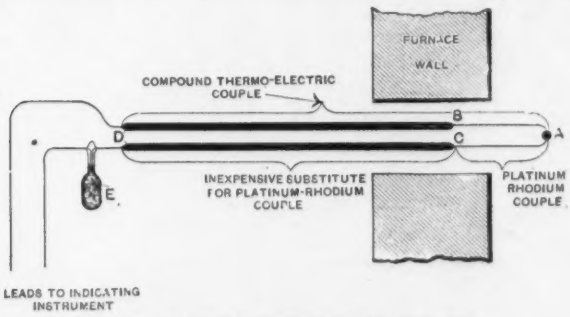


FIG. 3.—DIAGRAM OF PYROMETER CIRCUITS.

Compound couples as illustrated by the diagrammatic sketch of Fig. 3 are used to reduce the cost. The inexpensive alloys employed for the extension of the couple are such that the two secondary thermo-electric effects at the junctions with the platinum and platinum rhodium elements neutralize each other if the temperature at these junctions does not exceed 1,200° F. The indications on the instrument will be the same as if the whole couple had been made of the precious metals.

Where there are varying temperatures at the cold end of the couple, use is made of a mercury compensator which automat ically changes the resistance of the circuit so that no correction is necessary throughout the working range of the recorder. This apparatus is the invention of Prof. W. H. Bristol, of the Stevens Institute of Technology, and is being manufactured at 45 Vesey Street, New York City.

An Interesting Telephone Transmitter Test.

A very striking and interesting employment of the sensitive carbon transmitter of the International Telephone Manufacturing Company, Chicago, was made this past summer in the "transmitophone" installed by it at Riverview Park, Chicago.

FIG. 1.—VIEW OF GARDEN, SHOWING SUSPENDED INSTRUMENT.

The instrument was used for transmitting vocal and instrumental solos from a room in the Casino to three different points in the garden. Fig. 1 shows the garden with one of the reproducing instruments suspended in the tree to the right of the center of the picture. These were placed up above the lamps and were painted black so they could not readily be seen. When used the music sounded as if the soloists were concealed in the tree. This entertainment proved to be one of the most attractive features of the evening programme, very few knowing that the results were obtained through the use of a telephone.

The producer consists of a telephone receiver specially adjusted for this class of work and provided with a large megaphone centered in the ear piece. Rubber-covered wire is used for connecting the reproducer with the sending station. The wire is run directly into the receiver and taped with rubber tape to prevent moisture entering the receiver. The remaining two reproducers are suspended in other parts of the garden. The accompanists' transmitter is suspended in the orchestra stand, as will be seen

FIG. 2.—TRANSMITTING PIANO ACCOMPANIMENT.

in Fig. 2 at the left of the piano. This transmitter is made highly sensitive and is connected by a separate circuit to the sending station with the soloists' head receiver.

For this class of work eighteen volts or twelve cells of No. "1900" dry batteries are connected directly in the circuit through the one ohm primary side of the induction coil, through the transmitter and back to the battery which completes the primary circuit.

The reproducing receivers are connected on what is known as a closed secondary circuit; that is to say, both terminals of the secondary winding are connected to the receiver or receivers. The switching box in this installation is provided for three re-

FIG. 3.—TRANSMITTING CORNET SOLO.

producing circuits consisting of three cam lever keys and arranged so that the transmitting circuit can be switched to any one of the three receivers or to any two or to all three at one time. The switching box is also provided with binding posts and terminals so that the various circuits may be readily connected.

The battery box is a neat oak case arranged for the capacity of two sets of eighteen cells with each set connected in series and arranged so that it can be connected in the circuit with 12, 18 or

24 volts to meet the necessary requirements. The batteries are connected to a spring jack so that connection with the telephone circuit can readily be made with a cord and plug.

The accompanists' transmitter circuit at the sending station is also provided with a spring jack so that the head receiver can readily be connected with a cord and connecting plug and in order that the transmitter may be promptly disconnected when the instrument is not in use. The granular carbon is made of the very

FIG. 4.—SENDING STATION.

hardest coal grains broken to the proper size, highly polished and thoroughly cleaned to prevent frying or sizzling.

The carbon is of such a high quality that one transmitter has been in use at Riverview the entire summer season. At each evening's entertainment when used continually for 15 or 20 minutes, it would become so heated from the heavy battery current that one could not bear to touch the outer cup or frame, yet the instrument has shown no signs of deterioration, and has never failed to properly operate.

Tests on Benjamin Clusters.

The Benjamin Electric Manufacturing Company, of Chicago, has recently had tests made on two of its clusters by the Electrical Testing Laboratories of New York. Fig. 1 shows the distribution of light in a vertical plane about a 400-watt cluster known as the "arc burst," the appearance of which is shown in Fig. 2.

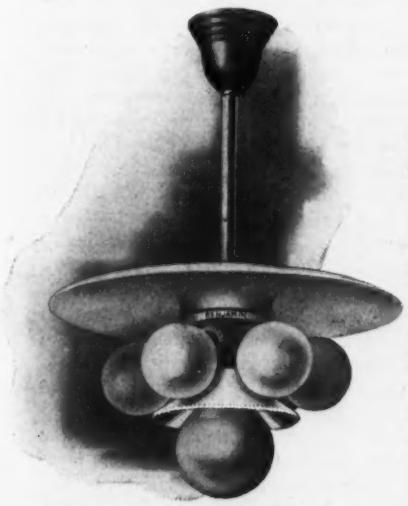


FIG. 2.—ARC-BURST CLUSTER.

This cluster was equipped with six 50-watt and one 100-watt spherical type gem filament lamps with round, partly frosted bulbs. The 100-watt lamp placed pendant on the bottom of this cluster was backed by a No. 73 Illuminating Engineering Company prismatic reflector covered with white enamel. The six 50-watt lamps were arranged radially without individual reflectors. The entire cluster was covered with a 17½-in. opal reflector. The inner curve of Fig. 1 shows the light distribution with the 100-watt lamp on the bottom burning. The intermediate curve shows the light distribution with the bottom lamp turned out and the six 50-watt lamps burning. The outer curve shows the light distribution with the whole cluster turned on. The mean spherical candle-power was as follows: Pendant lamp alone, 25; radial

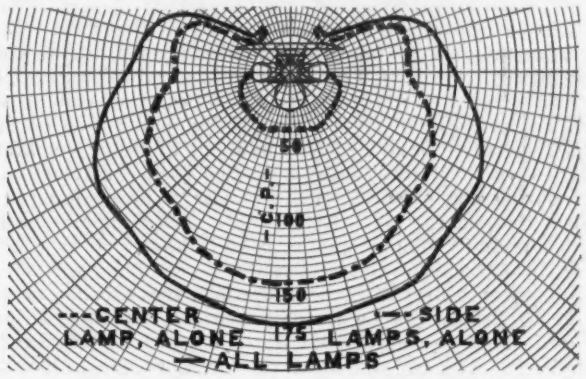


FIG. 1.—DISTRIBUTION OF LIGHT ABOUT A 400-WATT CLUSTER.

lamps alone, 81; all lamps, 103. The mean lower hemispherical candle-power was: Pendant lamp alone, 36; radial lamps alone, 107; all lamps, 141.

Another cluster tested is that known as the "anti-night." The light distribution about this cluster is shown in Fig. 3 and the cluster itself in Fig. 4. This cluster was equipped with the new high-efficiency 50-watt lamp, five being arranged radially, and one pendant. Each lamp had a fluted opal bell reflector, the maximum diameter of the reflector being 5⅜ and the depth 3⅜ in. The opal reflector over the whole cluster was 17½ in. in diameter. The inner curve, Fig. 3, shows the light distribution with the bottom lamp only turned on and so gives the photometric curve of the particular opal bell reflector used. The intermediate curve shows the light distribution with the radial lamps only turned on and the outer curve shows the light distribution with the whole cluster burning. The mean spherical candle-power was as follows: Radial lamps alone, 56; pendant lamp alone, 13; all lamps, 67. The mean lower hemispherical candle-power was 80 for the radial lamps alone, 22 for the pendant lamp alone and 102 for all lamps.

These clusters are provided with a commutating switch whereby the bottom lamp, the radial lamps or the whole cluster can be turned on at will, as was done in these tests. This brings out one of the advantages of the incandescent cluster for some locations as compared with arc or large incandescent lamps, namely the "turn-down" feature. Part of the lamps can be turned off without destroying the symmetrical appearance of the cluster.

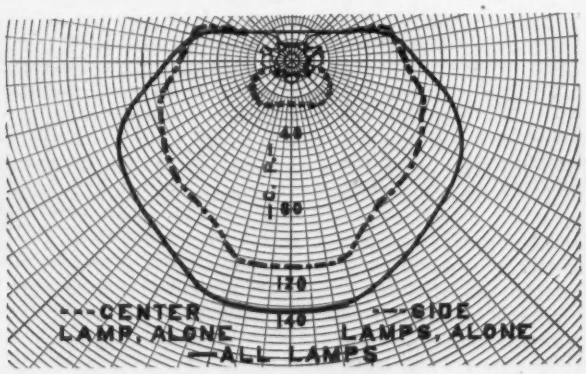


FIG. 3.—DISTRIBUTION OF LIGHT ABOUT A 300-WATT CLUSTER.

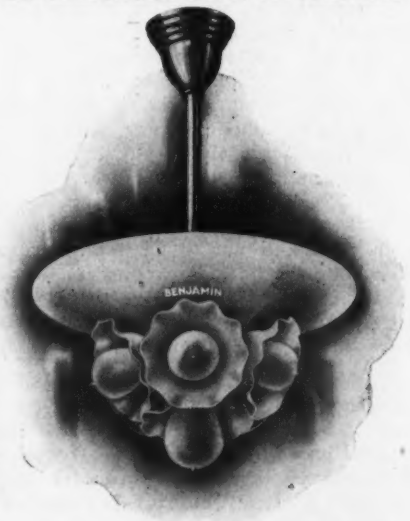


FIG. 4.—"ANTI-NIGHT" 300-WATT CLUSTER.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The more seasonable weather of the past week has, according to the reports of the mercantile agencies, stimulated trade and commercial business generally, and the most critical observation of affairs at this time fails to discover anything other than a continual expansion of the country's prosperity. Holiday trade preparations and sales have been so far encouraging, and Spring business is of good volume as a whole. Colder weather favored seasonable distribution of merchandise, but there is still much complaint of traffic conditions. Congestion on the railways was increased by the destruction of vessels during the recent Gulf storm and a heavy tonnage of freight is delayed thereby. Retail trade shows improvement in nearly all sections and mercantile collections are more prompt. Returns from the iron and steel industry continue satisfactory. Pig iron prices continue to move upward, the advance ranging from $1 to $2 per ton on goods purchased for 1907 delivery. Bar iron is up $3 a ton, and Bessemer billets have advanced $1 at Pittsburg. The ore shipments in October eclipsed previous records and the season's movement is expected to approximate 37,000,000 tons. Structural material is in good demand. Strong conditions in copper ruled the domestic and foreign markets throughout the week. Prices at the close of the week were at the same level for high conductivity and casting grades that have been maintained for over two weeks. Producers' prices for large tonnages are: Electrolytic, first quarter of 1907, 22½ to 23c.; Lake, January to March, 22½ to 22¾c. Prime Lake for December brings between 23½ and 24c. Reports from leading crops are favorable. Cotton has not been hurt by frosts to the extent feared, and freer sales of the staple have helped Southern trade and collections. The business failures for the week ending Nov. 1, according to *Bradstreet's* report, numbered 163, against 184 in the week previous and 160 in the corresponding week last year.

LOEB MEMORIAL HOME.—On October 27, a special train conveyed about 200 guests from the Grand Central Depot to East View, N. Y., where carriages and automobiles conveyed the visitors to the grounds of the Solomon and Betty Loeb Memorial Home for Convalescents, to attend the dedication exercises. This Home has been founded by Dr. Morris Loeb, of New York City, as a home for convalescents received from hospitals or their own homes. One particularly noteworthy condition of the deed of gift is that "No discrimination shall at any time be made by the Directors of the Home by reason of the faith, nationality or pecuniary condition of any applicant for admission to the Home." The Home consists of a central administration building, surrounded by six cottages, stable, barn and pump house, occupying 68 acres of elevated land in Westchester County. The buildings were designed by Mr. A. W. Cordes and erected by Messrs. George Mertz's Sons, of Portchester. The buildings are equipped in most modern and complete style throughout, being electrically lighted and inter-connected by telephone service and heated from a central plant. The grounds are electrically lighted and all power is obtained through motors supplied from the lines of the Westchester Lighting Company. In the pump house there is quite an array of motors for various services, and a very complete switchboard with recording and indicating instruments. All the electrical distribution is in underground conduits, having been installed by Messrs. Reis & O'Donovan, the electrical contractors, the electrical work having been designed and supervised by Mr. Henry Floy, the consulting engineer.

TELEPHONIC MANUFACTURING.—The gross business of the Western Electric Company for the first nine months of 1906 has been at the average rate of $5,800,000 monthly, showing a total gross business for the year if the rate is maintained of $70,000,000. Total gross sales for 1905 were $44,145,753. The Western Electric Company is swamped with orders. The company is badly behind in filling its orders for almost every class of telephone apparatus manufactured except instruments. It will require until next March for the company to catch up with the orders for certain classes of material. The company, it is stated, has been making a good thing out of the advance in copper. It has a number of contracts calling for the delivery to it by wire manufacturers of copper wire at 19 cents per pound. All wire used in installation or resold as wire is now being billed by the Western Electric at 24 cents, showing a profit of five cents per pound. On the other hand, many of its wiring and other contracts were made on the basis of cheaper copper than now obtains. The Western Electric has been obliged to borrow large amounts of money this year to finance its requirements. The present floating debt, it is said, is between $12,000, 000 and $15,000,000.

WILKINSON STEAM TURBINE COMPANY.—The permanent organization of this company has been effected and arrangements for putting its products on the market are being completed. It will build steam turbines and allied machinery under the inventions of Mr. James Wilkinson, formerly of Birmingham, Ala. These inventions are said to apply to a wide range of turbine improvements, protected by a great number of United States and foreign patents which cover, broadly, systems of construction, of operation, and of regulation, as well as numerous detail improvements in many of the features essential to a first-class turbine, and to advance in that field beyond present practice. It is believed by the promoters of this company that the Wilkinson system and patents cover the lines upon which the advance of the steam turbine must be made, both in marine and in stationary practice. The Wilkinson turbine will be built at the Corliss Steam Engine Works, Providence, R. I., and the executive office of the company is at that place. New York and other offices will be established in due season.

CROCKER-WHEELER SALES.—Among the recent sales of direct-current apparatus secured by the Crocker-Wheeler Company, of Ampere, N. J., appear the names of prominent firms who have been using for years Crocker-Wheeler machines almost exclusively for machine tools, lighting and power and who know from experience the advisability of purchasing C.-W. machines. These are only a few of the orders received. The sales are as follows: Peter Doelger's brewery, New York, one 200-kw and one 150-kw, 125-volt, 100 r.p.m. generator driven by Watts-Campbell engines; Pittsburg & Conneaut Dock Co., Conneaut Harbor, O., one 500-kw, 250-volt, 125-volt generator; Buckwatter Stove Co., Royersford, Pa., one 100-kw, 250-volt generator; Eton, Cole & Burnham Co., Bridgeport, Conn., one 200-kw, 250-volt generator; Midvale Steel Co., Philadelphia, Pa., one 275-hp, 220-volt motor and one 325-hp, 220-volt motor; National Tube Co., McKeesport, Pa., three 75-hp, 230-volt motor; fourteen 30-hp, 220-volt, and nineteen 6-hp, 220-volt motors; Brown & Bigelow, St. Paul, Minn., one 65-kw, 250-volt generator; Keller Pike Co., Esopus, N. Y., two 35-kw, 125-volt, 300 r.p.m. generator. Wm. Anderson, Philadelphia, Pa., two 50-kw, 250-volt, 275 r.p.m. generator, to be installed at the V. C. Sweatman Building, 5th and James Sts., Philadelphia, Pa.

TARIFF ON MICA PLATE.—In a decision last week Appraiser Fischer, of the United States Board of General Appraisers, overruled the protest of the Westinghouse Electric & Manufacturing Company in the matter of tariff charges on mica plate. Duty was assessed by the collector at the rate of 12 cents per pound and 20 per cent at valorem under the provisions of paragraph 184 of the act of 1897, as cut or trimmed mica. The importer claimed that the merchandise is properly dutiable either as an unenumerated manufactured article at the rate of 20 per cent ad valorem under section 6 or as an article composed wholly or in chief value of earthy or mineral substance not specifically provided for under paragraph 97 at the rate of 35 per cent ad valorem.

GENERAL ELECTRIC MANAGERS.—The principal branch office representatives of the General Electric Company from all over the United States held a meeting at Schenectady last week. First Vice-president Griffin presented facts regarding the tremendous growth of the company's business, pointing out the increases in factory facilities which are being pushed to completion as rapidly as possible to care for the insistent demand for electrical machinery and supplies. The managers were all especially interested in the additions to the building at the local plant where large size Curtis steam turbines are made. The capacity of the turbine shop is being practically doubled, although it is already the largest building in the world devoted exclusively to steam turbine production.

EQUIPMENT FOR PASCO, WASH.—We are advised by Mr. L. J. Corbett, 607 Empire State Building, Spokane, Wash., that the Pasco Light & Water Company have signed contracts for equipment for a 100-hp plant. It is to supply electricity for motors and lamps to the town of Pasco. The source of power is to be a gas producer and engine. The pump for the water supply will be electrically driven and is to be situated at a well on the bank of the Columbia River, about one mile from the power house. The electrical equipment is 2,300-volt, three-phase, 60-cycle. The plant comprises a Smith gas producer, Rathbun three-cylinder gas engine, Gould triplex pump (submerged), and a General Electric generator, induction motor, switchboard, etc.

WIRELESS FOR THE "PRINCESS ANNE."—The steamship *Princess Anne* of the Old Dominion Line left New York, October 27, on her first trip with wireless telegraph aboard, the De Forest system having been installed. This is the first steamer equipped under the recent contract with the Old Dominion Line.

Financial Intelligence.

THE WEEK IN WALL STREET.—In spite of high money rates at New York the speculative stock market showed bullish tendencies, particularly in the latter part of the week. The increase in the Pennsylvania Railroad dividend rate to a 7 per cent basis had a good effect and no disappointment was caused by the decision of the directors of the United States Steel Corporation to pay only ½ per cent for the September quarter on the common shares. Political uncertainties were generally regarded as being the principal reason for the hesitation which prevailed in speculative circles; although the action of the money market was also such as to create conservatism. The advance in call loan rates from 6 to 9 per cent was regarded as mainly the effect of the November disbursements, and, for that reason, only a temporary incident. At the end of the week the market had a strong tone, although the advances were checked before the close by a rise in exchange rates. The electrical stocks generally are a trifle stronger and show fractional advances. Allis-Chalmers common closed at 16⅝, and preferred 45⅜, the first figure being the lowest of the week and the second the highest. General Electric made a net gain of 1 point, closing at 175, which was the highest price reached during the week. The last quotation of Westinghouse was 154½, which was also the highest. Brooklyn Rapid Transit made a net gain of 2 points, closing at 80¾, and Inter-Metropolitan, both common and preferred, closed with net gains, the common at 38¼ and preferred at 77½. Little business was done in Metropolitan Street Railway, the closing quotation being 197. Western Union is quoted at 86, and American Telephone & Telegraph at 137¾. The market for outside securities was neglected most of the week. Brokers on the curb complained that their customers wanted nothing but mining shares and they had to humor them or do nothing. Following are the closing quotations of November 5:

NEW YORK

	Oct 30	Nov. 6		Oct 30	Nov. 6
Allis-Chalmers Co.	16⅞	16¾	General Electric	173½	176
Allis-Chalmers Co. pfd.	44⅞	44¾	Hudson River Tel	...	...
American Dist. Tel	25	...	Interborough Rap. Tran.	...	...
American Locomotive	74⅛	74½	Mackay Cos.	71	...
American Locomotive pfd.	110	112½	Mackay Cos. pfd.	69⅞	69
American Tel. & Cable	87	...	Marconi Tel	...	...
American Tel & Tel.	...	138	Metropolitan St. Ry.	...	...
Brooklyn Rapid Transit	78½	81⅛	N. Y. & N. J. Tel.	...	...
Electric Boat	16	...	Western Union Tel.	86¼	86
Electric Boat pfd.	65	...	Westinghouse com.	153	159
Electric Vehicle	12	...	Westinghouse pfd.	...	...
Electric Vehicle pfd	18	...			

BOSTON

	Oct 30	Nov. 6		Oct. 30	Nov. 6
American Tel & Tel.	135¾	138½	Mass. Elec. Ry. pfd	68	67½
Cumberland Telephone	...	...	Mexican Telephone	...	3⅝
Edison Elec. Illum.	234½	...	New England Telephone	129¾	128
General Electric	...	175	Western Tel & Tel	9	...
Mass. Elec. Ry.	...	...	Western Tel. & Tel. pfd	...	80

PHILADELPHIA

	Oct. 30	Nov. 6		Oct. 30	Nov 6
American Railways	51⅛	52	Phila. Electric	8⅛	8⅜
Elec. Co. of America	11¼	11¼	Phila. Rapid Trans.	27⅜	27⅛
Elec. Storage Battery	70	70¼	Phila. Traction	97⅝	97⅜
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Oct. 30	Nov. 6		Oct. 30	Nov. 6
Chicago City Ry.	130	...	National Carbon	85	...
Chicago Edison	...	...	National Carbon pfd.	117	...
Chicago Subway	53¾	...	Union Traction	...	4⅛
Chicago Tel. Co.	...	118	Union Traction pfd.	...	...
Metropolitan Elev com.	25	...			

BELL TELEPHONE BONDS.—In discussing new bond issues of the American Telephone & Telegraph Company, the *Wall Street Journal* remarks that the sluggishness of the security is due in part also to the impression that competition is making inroads upon the company's business. In some parts of the country this is to some extent true, but as a whole the problem is not how to get business, but how to provide the plant and equipment to take care of what is offering. It is in the problem of financing expansion that real difficulty lies. There need be little concern as yet about the mere question of expansion itself. It is rapid enough as may be readily shown by the monthly instrument statements. The September statement affords the following data:

Nine months, gross output	1,680,296
Nine months, instruments returned	555,717
Nine months, net output	1,124,579
Total instruments outstanding Sept. 30, 1906	6,822,837
Total instruments outstanding Sept. 30, 1903	3,608,718

In the short space of three years, the instruments of the company in use have very nearly doubled in number. The evidence of rapid growth is clear enough. An important feature of this growth, moreover, is that, judging from the testimony of the statistics, it is increasing in permanence. The following percentages represent the proportion of returned instruments to the gross output in the last four years when the output has been doubling:

1906	33%
1905	35%
1904	42%
1903	44%

The steady decrease in the percentage of returned instruments is quite significant. The decrease from 1903 to 1906, or three years, is 11 per cent of the gross output. It cannot be said, therefore, that it is on a basis of fear as to growth or as to the character of the growth that a tendency for the stock to lag is being shown.

CONNECTICUT PURCHASE.—The negotiations for the purchase of the Connecticut Railway & Lighting Company by the New York, New Haven & Hartford Railroad have been completed and the transaction will take effect December 1. The Connecticut Railway & Lighting Company controls a number of electric properties in Connecticut, including 186 miles of city and interurban railway lines. The New Haven & Hartford, within the past few weks, sold all its holdings in Massachusetts street railway properties, turning the stock over to the New England Investment & Security Company. This was done because of the opposition in Massachusetts to the control of the electric lines by the railroad company. The Connecticut Company has outstanding $9,191,000 common and $5,809,000 preferred stock. Outside of the Consolidated Railway Company, which was the New Haven's holding company for its Massachusetts electric roads, the Connecticut Railway & Lighting Company is the largest combination of electric railway lines in New England. It also operates large lighting plants in Greenwich, Norwalk, Waterbury, Bridgeport and New Britain. Mr. A. M. Young has been the energetic president.

GENERAL ELECTRIC STOCK.—The notice of President Coffin of the General Electric to the stockholders calling for a special meeting to be held at Schenectady November 20 to vote to increase the capital stock by 200,000 shares, states that since January, 1906, when $6,000,000 stock was issued to the shareholders, the business of the company has rapidly increased, shipments to customers during the first eight months of the present fiscal year having exceeded those for a like period the previous year by more than 30 per cent. This enlarged business involves a corresponding absorption of capital in factories and facilities in materials, etc. In view of this the directors propose to issue $11,000,000 at the present time or one new share for each five outstanding. Other details have already been given as to this increase of stock.

SOUTHERN NEW ENGLAND TELEPHONE.—The Southern New England Telephone Company contemplates an additional issue of stock. A special meeting of stockholders has been called for November 7 to vote on the question, and it is probable that the outstanding stock will be increased from $5,500,000 to $6,500,000. The last stock issue was in April, when $500,000 worth was put out. The authorized capitalization is $10,000,000, and of the outstanding stock 33⅓ per cent is owned by the American Telephone & Telegraph Company.

MANILA ELECTRIC BONDS.—Application has been made to the New York Stock Exchange to list $150,000 additional 5 per cent 50-year first lien and collateral trust sinking fund bonds of 1953 of the Manila Electric Railway & Lighting Corporation.

CHICAGO PNEUMATIC TOOL reports net profits for the quarter of $254,069 and a surplus of $115,130. The total surplus at the date of September 30 was $808,487.

GENERAL NEWS.

Construction News.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has purchased a tract of land at North Birmingham, on which, it is said, a power plant will be erected.

MOBILE, ALA.—The Electric Lighting Committee on Oct. 30 decided to recommend to the General Council at its meeting Nov. 15 the acceptance of the bid of the Machinery Sales Company, of Cincinnati, Ohio. The first bid is for the erection of a municipal lighting plant at a cost of $110,000. The alternate bid proposes to furnish 450 or more alternating-current enclosed arc lamps, 6.6 amp. and 72 volts at the arc, to be lighted on an all-night schedule, for a period of ten years at $58 per lamp per year; the market lamps to be furnished for $53 per lamp per year; the municipal building to be supplied on a meter basis, and the schedule of rates to all customers of the company, which is a minimum of 4½ cents and a maximum of 8 cents per kw hour, with a discount of 10 per cent on all bills paid on or before the 15th of the succeeding month. The city is also to get 2½ per cent of the gross earnings to be derived from the sale of electricity for light and power in the city of Mobile other than the city contract.

FORT SMITH, ARK.—The Pioneer Telephone & Telegraph Company has filed notice of its increase in capital stock from $3,000,000 to $10,000,000.

SILOAM SPRINGS, ARK.—The Siloam Springs light and water plant has been leased by the City Council for a term of three years to A. Perrine, beginning Nov. 1. The city receives a rental of $50 per month.

GRIDLEY, CAL.—The City Council is considering the construction of an electric light plant.

LOMPOC, CAL.—J. Kobloth, H. A. Keller and C. P. Baird have secured a franchise for an electric light and power plant.

MOUNTAIN VIEW, CAL.—The Mountain View Gas & Electric Company has purchased a site for its proposed plant, and work will begin at once.

MARYSVILLE, CAL.—The Marysville & Nevada Power & Water Company has decided to establish an electric power and irrigation system along Yuba River.

TURLOCK, CAL.—The question of constructing water works and an electric light plant is under consideration here. N. C. Hultburg and E. B. Osborn are interested.

LOS ANGELES, CAL.—A petition has been presented to the City Trustees of Ocean Park by the Los Angeles-Pacific Railway Company, asking permission for a right of way over Mildred Avenue from Pacific Avenue to the ocean front.

REDDING, CAL.—The California & Inland Empire Railroad Company is reported to be surveying eastward from Eureka, with Redding and Alturas as important points, on a line that will ultimately extend to Casper, Wyoming. The distance is 135 miles or 140 miles, and the survey is now completed as far as the western border of Trinity County, a distance of 70 miles.

ELMWOOD, CONN.—The Whitelock Coal Pipe Company has awarded the contract for the construction of its new power house to the B. H. Hibbard Company.

GREENWICH, CONN.—The Connecticut Railway & Lighting Company has recently enlarged and increased the efficiency of its plant on the Steamboat Road. The system has been changed from 125 cycle to 60 cycle, two-phase system. Three new generators, switchboard and other equipment have been added to the plant.

MAPLETON, CONN.—The Consolidated Railway Company is arranging to discard the boilers and engines at the power plant in this place and to furnish electricity to operate its system from the lower plant at Springfield. Alternating-current motor generators will be installed to operate the lighting plant and for operating the pumps for the village water company.

BRIDGEPORT, CONN.—The negotiations for the purchase of the Connecticut Railway & Lighting Company by the New York, New Haven & Hartford Company are said to have been completed, and the announcement is made that the transaction will take effect Dec. 1. The Connecticut Railway & Lighting Company controls a number of electric properties in Connecticut, including 186 miles of city and interurban railway lines.

WILMINGTON, DEL.—Anthony Higgins, representing the Commercial Heat, Light & Power Company has applied to the Board of Street and Sewer Directors to grant a franchise to the Delaware Electric Transmission Company, guarantor of the electric feature of the company's franchise, giving it permission to open the streets and set poles to carry the electric wires, which are to be mainly underground, and in connection therewith asked for an extension of 21 days in which to make the first payment, which if the board grants a franchise to the Delaware Transmission Company will be divided. Under the terms of the franchise the Commercial Heat, Light & Power Company is to pay the city $50,000, in four equal payments. The Commercial Company is to take the gas end of the project.

CORNELIA, GA.—The citizens have voted to issue bonds for water works and an electric light plant.

ATLANTA, GA.—The Atlanta, Griffin & Macon Electric Railway is now making surveys for locating its route from this city to Macon.

ATLANTA, GA.—The Georgia Railway & Electric Company is preparing to make further extensions to its system of interurban lines. The electric railway will be extended to Buckhead, a distance of four miles. The line to East Point will be extended to Hopeville, and the Decatur line will be built to Stone Mountain via Clarkston, adding ten miles to the Eastern branch of the company. These extensions will add 18 miles to the system. In addition to this the company is spending $600,000 this year in laying double tracks and in additions to its power plants.

SPRING VALLEY, ILL.—The Spring Valley Telephone Company has increased its capital stock from $10,000 to $15,000.

STONINGTON, ILL.—The Village Board has decided to issue $15,000 bonds for water works and an electric light plant.

CHICAGO, ILL.—The Metropolitan Telephone & Electric Company has changed its name to the Mullins River Fruit Company.

PEORIA, ILL.—The Peoria Gas & Electric Light Company has applied to the City Council for a 25-year franchise for the electric lighting privilege in this city.

KANKAKEE, ILL.—The Kankakee Electric Light Company is contemplating extensive improvements to its system in this place. The plans call for a new plant to be built on the south side of the Kankakee River, at a cost of about $125,000.

BLOOMINGTON, ILL.—At a meeting held Oct. 26 the City Council voted to accept the offer of the Illinois Traction Company to furnish 300 arc lamps free, in consideration of a renewal of the street-railway franchise, now about to expire.

CHICAGO, ILL.—Official notice that the independent telephone interests have leased the telephone franchise of the Illinois Tunnel Company, thereby gaining an entrance into Chicago, has been given to the city by the general counsel of the independent interests. It has been announced that the new company is financially prepared to begin at once the development of the automatic service, extending it to all sections of the city, and that one hundred thousand subscribers will be served as rapidly as the instruments and extension can be installed and constructed.

NORTH JUDSON, IND.—Vessely & Borkovee have secured a franchise for an electric light plant.

MONROVIA, IND.—The Monrovia Mutual Telephone Company has increased its capital for the purpose of securing a new switchboard and making extensions and other desired improvements.

COLUMBIA CITY, IND.—The directors of the Whitley County Farmers' Mutual Telephone Company have decided to expend a large sum in the installation of new equipment and for the making of numerous improvements.

CHESTERTON, IND.—The Northern Indiana Telephone Company has decided to install a modern switchboard in its exchange at this place. The company has recently completed local exchanges at Lowell and St. John, and is now planning for the construction of a number of improvements and extensions.

RUSHVILLE, IND.—S. G. Gregg, city clerk, writes that the Ft. Wayne Electric Works, of Ft. Wayne, have secured the contract for all the electrical apparatus for the electric light and water works for $6,500, and the Hooven-Owen-Rentschler Company, of Hamilton, Ohio, the contract for the engine, at $3,750.

INDIANAPOLIS, IND.—The steam and electric railways entering this city have secured a temporary restraining order against the city to prevent it from exacting payment for electric lights at street crossings in accordance with an ordinance recently passed by the Council. The restraining order also prevents the Indianapolis Light & Power Company from turning out 96 lights at crossings in compliance with a recent order of the City Council. The matter will come up for a permanent hearing soon and extensive litigation is likely to grow out of the attempt of the city to compel the railroads to light the crossing in the city.

SAPULA, I. T.—The franchise given by the City Council to J. A. Boyd, for an electric light plant has been accepted. Mr. Boyd states that the machinery for the plant has been purchased.

WICHITA, KAN.—The Citizens Electric Light & Power Company has secured a franchise from the city, and has arranged all preliminaries for establishing a plant.

LA CROSSE, KAN.—The City Council has awarded the contract for the construction of the power house for the electric light plant to H. M. Stover. Work will begin immediately.

LEAVENWORTH, KAN.—The Kansas City Western Electric Company, of Kansas City, Mo., is considering the erection of a new power house at Leavenworth. C. F. Holmes is president.

OSBORNE, KAN.—S. W. Grubb has bought a half interest in the electric light plant from F. A. Higley for a consideration of $7,000. Mr. Grubb will have charge of the business department and Mr. Higley will look after the mechanical work.

COFFEYVILLE, KAN.—John H. Heckman is planning to begin work on his electric light plant at Caney in a short time and expects to have

the plant in operation early in the spring. Mr. Heckman will install the machinery used in the Coffeyville electric light plant before the plant was enlarged.

OWENSBORO, KY.—Extensive improvements in the plant of the Home Telephone Company have been decided upon by the new owners, the Central Home Telephone Company. A large part of the system will be constructed and the switchboard capacity will be increased. The reconstruction work will not be started until next spring.

NAPOLEONVILLE, LA.—The electric light committee has awarded the contract for the construction of the municipal light plant to Henry Widmer, of New Orleans, for $7,264. The contract calls for the plant to be in operation 75 days after the signing of the contract.

NEW IBERIA, LA.—W. P. Conery, promoter of the Bayou Teche Railway & Light Company is making preparations to commence operations. Several sites for a power house have been inspected. The question of purchasing the municipal electric light plant has been considered, and if it can be secured at a satisfactory price the plant may be taken and enlarged to meet the needs of the railway. In the event of purchase the company would furnish electricity to light the town.

BATH, ME.—The Board of Aldermen has granetd the petition of the New England Telephone & Telegraph Company for permission to lay conduits on several streets in the city.

PRESQUE ISLE, ME.—The Aroostook, Maine & New Brunswick Electrical Power Company is erecting a new building at Fort Fairfield, which will be used as a distributing station for the village of Presque Isle.

BEVERLY, MASS.—A new power house is being built for the Travers factory for the purpose of operating the factory by electricity.

SALEM, MASS.—The Salem Electric Lighting Company has decided to put all its high tension wires underground, and will begin the work early next year.

DRACUT, MASS.—At a special town meeting, held Oct. 30, it was voted to light the town with electricity. It is proposed to have 100 lamps furnished by the Lowell Electric Light Corporation.

TAUNTON, MASS.—Now that the street lighting system of the municipal lighting plant has been extended to East Taunton the advisability of having the power circuit extended to this section of the city is being seriously discussed and it is expected that some action in regard to the matter may be taken at an early date.

PAW PAW, MICH.—W. H. Mason, village clerk, writes that it has been decided to postpone the receiving of new bids for constructing the proposed dam until the next spring or summer.

GRAND RAPIDS, MICH.—The Grand Rapids Hydraulic Company has recently ordered dynamos to operate a private electric lighting plant. The machines will be operated by the gas engines, which are used in connection with the pumping machinery in the plant.

CROOKSTON, MINN.—The Council has decided to issue $10,000 in bonds for an electric light plant.

ST. CLOUD, MINN.—The Northwestern Telephone Exchange Company contemplates rebuilding the local exchange at once at a cost of $50,000.

JONESBORO, MISS.—W. W. Williams & Co., of Nashville, Ky., have purchased the entire issue of the Nettleton & Jonesboro Electric Railway Company. The company will finance and construct the road. Preparations are being made to commence operations immediately.

CORINTH, MISS.—The Corinth & Shiloh Electric Railway has commenced work on the foundation of the power house, which is to be built at the junction of the Illinois Central & Southern Railway, just east of the town. The power house will be equipped with boilers of 2,500 hp and four dynamos of 333 kw each. The directors of the road are Simon Rubel, W. J. Lamb, M. T. Bynum and Joseph Lannon.

ANACONDA, MONT.—The Bell Telephone Company has taken out a permit for its new building to be erected at Idaho Street and Broadway, to cost $60,000.

BEATRICE, NEB.—The City Council has granted Wymore H. Clark, Jr., of Omaha, a franchise for an electric light plant.

TECUMSEH, NEB.—The city of Tecumseh is contemplating the erection of a new electric light plant. By the end of the year its old plant, which it has entirely outgrown, will have final payment made upon it. The city then can proceed, without exceeding its limit of indebtedness, to issue bonds for a modern plant to meet all requirements.

LACONIA, N. H.—The Laconia Electric Lighting Company has started the power plant at the street railway station, to furnish electricity for the railway. This station will be operated until the new Deisel engine is installed in the lighting company's plant.

EXETER, N. H.—The Newmarket Electric Light & Power Company, which controls the Newmarket & Durham Telephone Company, has sold the telephone system to the New England Telephone & Telegraph Company for $2,000. William H. C. Follansby, receiver of the Newmarket Electric Light & Power Company, has received an order from the court permitting him to make needed repairs to the power plant.

ORANGE, N. J.—Bids were opened October 29 by Common Council for installing a plant for lighting the streets by electricity, and the following are reported to be the bids received: Johnston, Livingston, Jr., & Company, of New York, N. Y., bid $48,599 for the entire plant, of which $32,265 was for the power station and $16,334 for the poles and street lines. Bellman & Sanford, Inc., to furnish all equipment for $53,444. Howe Company, of New York, N. Y., to erect line equipment for $19,950. Hooven, Owens, Van Rensselaer Company, of Hamilton, Ohio, bid $34,400 for power station and appurtenances. Crocker-Wheeler Electric Company submitted 12 figures on various kinds of generators. Stevens-Hewitt Eng'g Company, of New York, N. Y., $33,621 for power station complete and $23,186 for pole line and equipment, a total of $56,807. Mackay Engineering Company, of Massillon, Ohio, bid on two forms of engines. D'Olier Engineering Company, Philadelphia, Pa., $35,375 for power station and $35,150 for street equipment, based on one type of equipment, and on another $32,750 for station and $35,300 for street work. Western Electric Company bid on generators, submitting 9 different propositions. It also bid $17,400 for the pole line with wooden poles and $19,450 for steel pole equipment. In addition to the bids for furnishing equipment of plant there was a proposition from Bellman & Sanford, Inc., to install, maintain and operate plant for any period from 5 to 20 years, furnishing 350 standard 2,000-cp series alternating current enclosed arc lamps, lighting the streets from dusk until dawn, for $21,000 a year or at the rate of $60 per lamp. To operate this equipment they will furnish and install on ground provided by the city convenient for coal and water supply, the building, with coal pocket, foundations, boilers, piping, engines, electric generators, switchboard, regulating apparatus, wiring, transmission lines, supports, connections and arc lamps for $70,000.

NEW YORK, N Y.—Plans are being prepared by the New York Edison Company for a five-story fireproof power house to be erected at 64th Street, near 3d Avenue.

BROOKLYN, N. Y.—Bids will be received until Nov. 12 by C. B. J. Snyder, superintendent School Buildings, New York City, for installing electric equipment in new school 8; also in the additions to School 30, Borough of Brooklyn.

SYRACUSE, N. Y.—Ground has been broken for a new combination power, light and heating plant in the rear of the Brown-Lipe Gear Company's factory to be used jointly by the Gear Company and the Kemp-Burpee Manufacturing Company in West Fayette Street. The building with machinery will represent an expenditure of between $50,000 and $60,000. There will be two separate systems which can be converted into one, each of twice the capacity needed by either concern. In case of a breakdown, therefore, either company can furnish the other with power and heat until repairs are made.

OGDENSBURG, N. Y.—The Pittsburg Reduction Company, owners of the St. Lawrence Power Company's canal at Massena, has purchased additional water power on the north shore of Long Sault Island, St. Lawrence River. The company has acquired property and rights along the American shore of Long Saulte Rapids, also franchises from the United States War Department in order to proceed with construction work. The company will build a dyke parallel with the island, commencing at the head of the rapids which will give a 26-foot fall and develop 25,000 hp power. The estimated cost of the project is $1,500,000.

CONCORD, N. C.—The Concord Street Railway is a new concern which proposes to build an electric line in Concord, with a capital stock of $125,000. W. C. Johnson, of Charlotte, is president; E. H. Brown, vice-president, and R. A. Brown, treasurer and general manager.

SANFORD, N. C.—The electric light plant owned by F. I. Thompson & Son was burned recently, the loss being estimated at $7,000. Mr. Thompson states that it will be rebuilt without delay.

STATESVILLE, N. C.—The town is considering bids and plans for the new electric light and power plant, the electricity for which will be supplied by the Southern Power Company, of Charlotte. Several sites are also under consideration.

VALLEY CITY, N. D.—W. T. Craswell, city auditor, writes that the question of improving the electric light plant is being discussed, but nothing will be done until the spring.

KENMARE, N. D.—The power plant of the Kenmare Light & Power Company was recently destroyed by fire, entailing a loss of about $10,000.

AKRON, OHIO.—The Northern Ohio Traction & Light Company, which recently took over the Canton-Akron system, acquired with it a coal mine near Midvale and is preparing to utilize this coal exclusively for its power station. If the fuel proves satisfactory it is probable that the small power station near Midvale will be abandoned and a substation erected at that point.

COLUMBUS, OHIO.—The Citizens Telephone Company, of this city, is rebuilding its plant at Elizabethtown.

AKRON, OHIO.—A company headed by Thomas H. Brooks has applied for a 50-year lighting franchise in the city.

HAMILTON, OHIO.—The City Council has passed an ordinance providing for the issue of $65,000 bonds, to repair and improve the electric light plant.

NILES, OHIO.—The Niles municipal lighting plant has just announced an all-night service. The city is planning to make important additions to the equipment of the plant.

CLEVELAND, OHIO.—Frazier, Fox & Spencer, consulting engineers, Rockefeller Building, are preparing plans for a large power plant for the Lake Erie Iron Works Company, Cleveland.

FREMONT, OHIO.—The Sandusky County Commissioners have granted a franchise to the Sandusky, Fremont & Southern Railway to construct its line through the village of Vickery.

MONTPELIER, OHIO.—The St. Joe Valley Traction Company is said to be planning to extend its line from Angola, Ind., through Montpelier to Pioneer to connect with the Toledo & Western Railway.

NORWALK, OHIO.—The United States Telephone Company has secured the controlling interest in the Local Telephone Company, which operates in Norwalk, Bellevue and other towns in Huron County.

LORAIN, OHIO.—The Citizens' Gas & Electric Company is replacing

all its old arc lamps with General Electric enclosed-arc lamps. The company will make important additions to its power equipment this winter.

CLEVELAND, OHIO.—The Cleveland, Bedford & Geauga Lake Traction Company is securing rights of way from Bedford into Cleveland. The company intends to build an independent entrance into the city. L. A. Smart is chief promoter.

BELLEVUE, OHIO.—The Bellevue Home Telephone Company is preparing to place its wires underground in conduits in the business district. The contract for this work has been placed with the Butterfield Construction Company, of New York.

SPRINGFIELD, OHIO.—The Springfield Railway Company has accepted a franchise for the extension of its line in Belmont and Columbus Avenues, opening up a new factory district east of the city. It is expected that work will start early in the spring.

TOLEDO, OHIO.—The Toledo & Indiana Railway Company is making a survey for a branch line from Delta to Defiance by way of Liberty, Center and Napoleon. It also has another route under consideration by the way of Wauseon to Napoleon and thence to Defiance.

TOLEDO, OHIO.—As a result of the low bid made by the Toledo Railways & Light Company for street lighting, the Board of Public Service is planning to add materially to the number of arc lamps on street corners, and many lamps are to be placed in the city parks.

CLEVELAND, OHIO.—The Bradley Electric Light, Heating & Power Company, which supplies a number of business and residence blocks in the central part of the city with light and power is laying conduits to extend its system to other buildings east of East Ninth Street. Improvements are being made to the plant, which is located in the Vulcan Building.

AKRON, OHIO.—The village of Tallmadge has offered to give $5,000 and a free right of way through the town to the Akron & Youngstown Fast Line, which is being promoted by Thomas A. Childs, of Akron. Mr. Childs claims that practically all the right of way has been secured and that construction work will commence in the spring.

GALION, OHIO.—Walter L. Ball, of Fredericktown, chief promoter of the Galion Southern Electric Railway, who proposes to build from Galion to Mt. Vernon, claims that the right of way has been secured, and as soon as the Galion council grants a franchise for the use of certain streets, the contracts for construction will be let and work started early in the spring.

COLUMBUS, OHIO.—The State authorities are still debating whether to install Nernst lamps throughout the capitol building and buy electricity or to install a lighting plant in the building to supply electricity for lighting purposes. The sum of $25,000 has been appropriated for illuminating and it is thought that a suitable plant can be installed for considerable less than that amount.

GENEVA, OHIO.—The franchise of the Geneva Electric Illuminating Company expires in the near future and the company wants a 10-year contract, the price to be $67.50 each for 46 lamps. On a shorter contract they ask $70 a year. The company is planning to make important improvements to its plant if it secures the contract. J. E. Latimer, of Cleveland, is at the head of the company.

ELYRIA, OHIO.—The Elyria Milling & Power Company has declined to accept the franchise offered by the City Council. The city wanted to reserve the right to require the company to place its wires underground after five years and to require the company to pay the city 5 per cent of the gross receipts after 10 years. The company has prepared a new franchise offering a reduction in the rate.

COLUMBUS, OHIO.—Before it takes definite action on the ordinance to appropriate $140,000 for additional equipment for the city lighting plant, the city will employ an electrical expert to report on the present condition of the equipment of the plant and on the prospects for commercial lighting for the city. The ordinance providing for electricity at 7 cts. per kw hour will be tabled until a report of the expert is received.

SALEM, OHIO.—The General Engineering Company, of Cleveland, Ohio, which has recently acquired the plant of the Salem Electric Light & Power Company is seeking a 25-year extension of the franchise. The company agrees to spend $70,000 in improvements if the grant is secured. Plans have been prepared for a new plant to include two 250-kw, direct-connected, alternating-current units with space for double the capacity.

MIDDLEFIELD, OHIO.—The Eldenbel Construction Company, of Cleveland, which has undertaken the refinancing and construction of the Cleveland & Sharon Traction Company, reports that the villages of Orangeville, Vernon, Kinsman and Green have subscribed the required amount to secure the building of a road through these towns. The inducement is offered to Middlefield of the location of a power station and division headquarters.

TOLEDO, OHIO.—The Toledo & Point Place Railway and the Ottawa Beach & Southern Railway Companies have been consolidated, forming the Toledo, Ottawa Beach & Northern Railway Company. The consolidated company has a capital stock of $1,500,000. Bonds to the amount of $1,500,000 will be issued to cover the indebtedness of consolidated companies and to be used in extensions and improvements. The directors are Henry A. Everett, Edward W. Moore, Louis F. Beilstein, F. W. Nutt and John F. Collins.

LAWTON, OKLA.—The Pioneer Telephone Company, which recently absorbed the Topeka & El Reno Telephone Company will construct another large building in this city.

OREGON CITY, ORE.—Surveys are now being made for the proposed electric railway to be constructed between this city and Molalla by the Oregon City & Molalla Railway Company.

RAINIER, ORE.—It is reported that about $10,000 will be expended for improvements at the Rainier electric power plant. W. Cooper Morris is one of the owners of the plant.

ROSEBURG, ORE.—T. R. Sheridan, owner of the Myrtle Creek Water, Light & Milling Company, writes that the proposed plant will cost about $10,000. No engineer has been selected as yet.

NANTICOKE, PA.—Work has commenced on the reconstruction of the Nanticoke dam with a view of utilizing the power for the operation of an electric power plant.

FT. MANSFIELD, R. I.—Bids will be received until Nov. 15 by Lieut. R. I. Taylor, constructing quartermaster, U. S. A., for furnishing and installing electric fixtures in the post exchange and the bowling alley.

PROVIDENCE, R. I.—Bids will be received until Nov. 16 by Jere H. Hall, chairman Joint Standing Committee of the City Council, for installing a ventilating and heating system, generators, belting and switchboard required for the additions and alterations to the Technical High School. Martin & Halls, 806 Union Trust Company Building, are the architects.

TIMMONSVILLE, S. C.—A. J. Brown, town secretary, writes that it is not proposed to construct a municipal electric light plant. The town will grant a franchise to any reliable company or person.

GREENVILLE, S. C.—The contract for installing the lighting system in the new addition to the McGhee Manufacturing Company's new mill has been let to the R. G. Auten Company, of Charlotte, N. C.

CANADIAN, TEX.—The Stockmen's Telephone Company has filed an amendment to its charter increasing its capital stock from $5,000 to $10,000.

TEMPLE, TEX.—It is reported that the Temple-Belton Traction Company will extend its line east from Temple to Marlin, a distance of about 30 miles.

SAN ANTONIO, TEX.—James D. McKeever, of Philadelphia, and associates, are interested in the project of building an interurban electric railway between San Antonio and Pleasanton, a distance of about 30 miles.

DALLAS, TEX.—A survey is being made for a proposed interurban electric railway to be built between Dallas and Waxahachie, a distance of about 30 miles. It is stated that Waxahachie is to be made the diverging point for other lines of the proposed system, one of which is to run to Ennis and Corsicana and the other to Hillsboro and Waco.

PROVO, UTAH.—M. F. Pack, of Provo, has petitioned the State Engineer for permission to divert 30-second feet of water from Provo River, to be conveyed 15,000 feet, where a power plant will be constructed to furnish electricity in Provo and other towns in Utah County.

RICHMOND, VA.—William S. Woodson, clerk, Committee on Light, writes that the contract for lighting the city has been awarded to the Richmond Passenger & Power Company for one year, with the privilege of extending for one year, contract to begin July 1, 1907. The contract calls for 800 lamps, more or less, of 1,200 cp. at $54.75 per lamp per year. He further states that the question of installing a municipal plant is being agitated and the contract was made for one year only in consequence. The prices are the same as those now in force.

SEATTLE, WASH.—The Seattle Electric Company is building a new power house south of Georgetown, which will cost $500,000.

BELLINGHAM, WASH.—M. Poletto, of Toad Lake, will soon install a water wheel on his property there for the purpose of operating an electric lighting plant.

ABERDEEN, WASH.—The Gray's Harbor Electric Company has secured the contract for lighting the streets of the city for a period of ten years at $80 per lamp per year.

NORTH YAKIMA, WASH.—The stockholders of the Yakima Intervalley Traction Company have subscribed $100,000 for the construction of the electric railway for this city and valley.

MAPLE FALLS, WASH.—A meeting of the citizens of Maple Falls was held Nov. 1 for the purpose of forming a stock company to build a telephone line between Maple Falls via Deming to Bellingham.

TRENT, WASH.—Frank McKean, of the Hydro Electrical Engineering Company, of Chicago, has secured the contract for constructing the dam and irrigation system of the Trent Power & Irrigation Company for about $10,000.

WATERVILLE, WASH.—Walter and Albert Higgs and Antin Kramer, of St. Andrews, under the name of the Farmers' United Telephone & Telegraph Company, have applied to the County Commissioners for a franchise to build a line northwest and north from Coulee City.

PROSSER, WASH.—Preparations are being made by the Hanford Irrigation & Power Company for the construction of its power plant at Priest Rapids. Contracts have been placed for the machinery for the electric plant to be delivered Jan. 1, and it is epected to have the plant in operation by May, 1907. The company expects to extend its transmission lines to Sunnyside, Prosser and on through the Yakima Valley to Kennewick and Pasco on the Columbia, and also contemplates the building of an electric railway to Prosser within two years. John H. McGraw, of Seattle, is president.

DELEVAN, WIS.—The Common Council has granted a 50-year franchise to the Milwaukee Electric Railway & Light Company.

BELOIT, WIS.—The plant and holdings of the Beloit Water, Gas & Electric Company has been purchased by the Union Trust Company, of Cincinnati, Ohio. The new owners propose to expend $200,000 in extension and improvements to the different properties acquired.

PESHTIGO, WIS.—The Peshtigo Lumber Company is making extensive improvements and additions to its plant. A new dam 200 feet long is under construction; a new power house is to be built and new machinery installed. The new plant will have a capacity of 500 hp and will cost about $30,000.

CHEYENNE, WYO.—A Colorado Springs syndicate, of which James F. Burns is the head, is negotiating with the city council for a street railway franchise.

NORTH BATTLEFORD, CAN.—R. C. Laurie has been appointed by this town to look into the water power possibilities of Jack Fish Creek.

SELKIRK, MAN.—The Ivel Motor & Machinery Company has purchased the plant and holdings of the Selkirk Light & Power Company The lighting company holds a perpetual franchise in Selkirk and has a 23-year franchise for supplying gas and electricity in Brandon.

WINNIPEG, MAN.—The City Council, not being able to grant a franchise to the Great Falls Power Company, which is headed by H. M. Byllesby, of Chicago, Ill., it is said that the company will not make another application to the Council, but will construct a plant on a site at Great Falls, on the Winnipeg River, owned by the company, and will furnish electricity in Selkirk, St. Boniface and other towns around Winnipeg.

HAMILTON, ONT.—The Hamilton Terminal Company has decided to erect an electric station here.

TORONTO, ONT.—The Toronto-Niagara Power Company will erect shops and sub-station on Dufferin Street.

PETERBOROUGH, ONT.—A new system of street lighting will be installed in this town by the Council at a cost of $50,000.

PORT ARTHUR, ONT.—The Nepigon Pulp & Paper Company has made an offer to the Council to supply power for $15 per hp per annum. The Council is considering the matter.

New Industrial Companies.

THE WESTERN POWER COMPANY has been incorporated by John Krischwing, of Spokane, Wash., and his associates, with a capital stock of $500,000.

THE TELEPHONE SPECIALTY COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $10,000, by Alexander MacGenthar and others.

THE TELELECTRIC MUSIC COMPANY, of East Orange, N. J., has filed articles of incorporation with a capital stock of $500,000. The incorporators are William Shillaber, Jr., John C. Mulford, and Harry H. Pycking.

THE CANADIAN ELECTRICAL & MOTOR COMPANY, of Toronto, Ont., has been incorporated here with a capital of $550,000, to manufacture electric machinery. The incorporators are: R. H. Nichols, W. Vandusen and W. A. Johnson, all of Toronto.

THE ATLANTIC ELECTRIC COMPANY (Inc.), of Norfolk, Va., has been chartered with Walter Hitt, president, and H. N. Brown, secretary and treasurer. The company proposes to conduct an electrical construction and supply business in Norfolk. The capital stock is $50,000.

THE A. & W. ELECTRIC SIGN COMPANY, of Cleveland, Ohio, has been incorporated by H. J. Walser, W. M. Knapp, C. J. Knudesen, Louis J. Grossman and Nathan Loeser. The company has been engaged in the manufacture of electric signs in Cleveland for several years and is planning to enlarge its business.

THE TELEPHONE MECHANICAL DIRECTORY COMPANY, of Columbus, Ohio, has been incorporated with a capital stock of $75,000, by G. S. Jones, M. Morris, O. Jones, E. H. Schwab, Clarence E. Melhope and Joseph R. Rohrer. The company will manufacture a patented device in which a list of telephone subscribers are carried on a tape and can be operated to find a telephone number instantly.

THE IVEL MOTOR & MACHINERY COMPANY, of Winnipeg, Man., has been formed by leading financial men of Winnipeg. The organization includes the names of James Stuart, of the Stuart Electrical Company; J. W. Flavelle, of the Flavelle Milling Company, Lindsay, Ont.; Andrew Kelly, of the Western Canada flour mills; Isaac Pitblado, and others. The company has taken over the plant and equipment of the Selkirk Light & Power Company. Along with this goes the perpetual franchise of the town of Selkirk to this company. The company also has a 23 years' franchise for supplying gas and electricity in the city of Brandon. Operations in the large works of the Ivel Motor & Machinery Company will be commenced at a very early date.

New Incorporations.

BOULDER, COL.—The Rocky Mountain Telephone Company has filed articles of incorporation with a capital stock of $10,000. The directors are T. S. Waltmeyer and others.

CRIPPLE CREEK, COL.—The Central Colorado Power Company has been incorporated, to develop water power on Grand River, in Colorado, to furnish electricity to Leadville, Cripple Creek, Denver, Colorado Springs and other mining towns. Myron T. Herrick, of Cleveland, Ohio, is president.

HIGHLAND, ILL.—Articles of incorporation have been filed for the Farmers & Merchants' Telephone Company, with a capital stock of $15,000. The incorporators are Leo. R. Brand, M. Cummings and John S. Koerner.

EFFINGHAM, ILL.—The Central Illinois Long Distance Telephone & Telegraph Company has filed articles of incorporation with a capital stock of $2,500. The incorporators are B. W. Kerr, C. E. Munday and T. C. Dore.

CRANDALL, IND.—The Mutual Telephone Company has filed articles of incorporation with the Secretary of State. The capitalization is $5,000. James Crandall, William Rundell, and J. L. Walk are the directors.

FORT WAYNE, IND.—The Manufacturers' Light & Power Company of Fort Wayne, Ind., has filed articles of incorporation with the Secretary of State, capitalized at $50,000. The directors are S. S. Hanna, John E. Roth, and others.

SOUTH McALESTER, I. T.—The Chickasha Railway & Electric Company has been incorporated with a capital stock of $100,000. Scott Jones, of Chickasha, is president.

BURLINGTON, IA.—Articles of incorporation have been filed for the Gate Telephone Company, with a capital stock of $10,000. The officers are William H. Taylor, president; Alfred J. Dean, vice-president, and Thomas Peebles, secretary and treasurer.

DEER CREEK, MINN.—The Deer Creek Telephone Company has been incorporated with a capital stock of $25,000.

JEFFERSON CITY, MO.—The Missouri Interurban Railroad has been chartered with a capital stock of $20,000, to be increased to $1,000,000 when the right of way has been secured and the line ready for work. The incorporators and the directors of the company are C. W. Thomas, Jefferson City; Bailey W. Lansdown, Centretown; F. P. Gemenden, Cedron; Henry Fricke, Prairie Home; A. W. Nelson and W. B. Kerens, Bunceton; J. H. Gunn, Otterville; J. D. Starke, Soleville; W. B. Meyers, Smithton, and J. W. Mellor, of Sedalia. The line has been surveyed and is to run from Jefferson City to Sedalia, a distance of 79 miles.

ORD, NEB.—The Farmers' Mutual Telephone Company has been incorporated with $25,000 capital.

BURLINGTON, N. J.—The Independent Telephone Company has filed articles of incorporation with a capital stock of $25, . The incorporators are Samuel Jeffrey and others.

NEW YORK, N. Y.—Articles of incorporation have been filed for the Queens Lighting Company with a capital stock of $10,000, by Frank E. Wiske and others.

BUFFALO, N. Y.—The Buffalo & Lake Traction Company, of Buffalo, a consolidation of the Buffalo, Dunkirk & Western and the Lake Erie Traction companies, has been incorporated with a capital stock of $3,900,000. The directors are L. B. Grant, W. J. Bagnell, Brooklyn; M. J. Dodge, C. H. Wener, New York.

STOCKPORT, OHIO.—Articles of incorporation have been filed for the Morgan County Farmers' Telephone Company with a capital stock of $5,000 by Charles D. Mosher and others.

XENIA, OHIO.—Articles of incorporation have been filed for the Xenia, Cedarville & Jamestown Traction Company with a temporary capital stock of $1,000 by George Little, Charles Darlington, R. L. Gowdy and others. The company proposes to construct a line between Xenia, Cedarville and Jamestown.

CLEVELAND, OHIO.—The Cleveland, Bedford & Geauga Lake Traction Company has been incorporated by L. A. Smart and others, of Cleveland, with a nominal capitalization of $10,000. Mr. Smart states that it is the intention to build a new line from Cleveland to Garrettsville by way of Bedford.

COLUMBUS, OHIO.—The Columbus, Magnetic Springs & Delaware Interurban Railway Company has been incorporated with $400,000 capital. The officers are W. M. Galbraith, president: Chris McGee, Jr., vice-president and treasurer; W. N. Embert, secretary. J. H. Leonard and J. L. Horn are directors.

TOLEDO, OHIO.—The People's Heat & Power Company, capital stock $400,000, and the Yaryan Light & Power Company, capital stock $100,000, have been incorporated in Toledo by Merwin Jackson, Homer T. Yaryan, Edward E. Dow, Thomas B. Guitteau, and George G. Brigham. H. T. Yaryan will be president and general manager of both of the new companies. The companies will apply for franchises for a lighting and heating system in competition with the Toledo Railways & Light Company and the Toledo Gas, Electric & Heating Company.

WEATHERFORD, OKLA.—Articles of incorporation have been filed for the Weatherford Electric Light & Power Company by W. E. Balcomb and others. The company has a capital stock of $10,000.

PERKINS, OKLA.—The Perkins Electric Light & Power Company has been incorporated with a capital of $5,000 by John Wagner, J. M. Boone and others to establish an electric light and power plant.

LAWTON, OKLA.—The Lawton Rapid Transit Railway Company has been incorporated, with a capital stock of $1,000,000, to build an electric railway in Lawton and vicinity, at a cost of $100,000. The incorporators are: Neal S. Doran and E. H. Shaufler, of Kansas City; W. M. Smith, H. A. Lloyd and J. Elmer Thomas, of Lawton.

PAISLEY, ORE.—The Moss Telephone Company has filed articles of incorporation with a capital stock of $3,000. The incorporators are Harry Bailey and others.

PORTLAND, ORE.—The Cowlitz Valley Railway & Power Company has been incorporated to build an electric railway from some point along the Lower Columbia, probably Kalama, to the headwaters of the Cowlitz and later a line from Portland to the Sound.

Legal.

ATTEMPT OF TELEPHONE COMPANY TO SUPPRESS NEWS OF ACCIDENT DOES NOT TEND TO SHOW LIABILITY.—In an action to recover damages from a telephone company for injuries received by the cable upon which the plaintiff was working, coming in contact with a live wire, through the alleged negligence of the company, evidence that the company's foreman requested the night editor of a local newspaper not to publish any account of the accident was held to be inadmissible. Such is evidence of a collateral matter only and does not tend to establish liability. Finn vs. New England Telephone & Telegraph Company, Supreme Judicial Court of Maine.

AN OFFER TO COMPROMISE A CLAIM FOR DAMAGES IS NOT AN ADMISSION OF LIABILITY.—Evidence that a telephone company, through its manager, offered to an employe, who had been injured by coming in contact with a live wire, while on duty, checks of the company covering the expenses of the accident and requested a receipt for the same, is inadmissible in an action against the company for damages. The rule is that an offer to purchase peace either with the intent to avoid a possible controversy or to end one that has arisen does not constitute and cannot be used in evidence as an admission of liability. Finn vs. New England Telephone & Telegraph Company, Supreme Judicial Court of Maine.

DUTY OF PERSON HANDLING WIRES AS LICENSEE.—It is a well-known fact that the wire used by electric lighting companies is a manufactured article bought and sold in the open market and a company which uses it may not be regarded as negligent because of its insufficient insulation unless it is alleged or proven that it knew or ought to have known that the insulation was defective. Therefore, where one handles an electric light wire of high voltage as a mere licensee the company owes him no duty to see to it that the insulation is perfect. On the other hand, where one voluntarily places himself in contact with a deadly wire he must be held to a degree of care such as is imposed upon all persons who intentially deal with dangerous things. Mangan vs. Hudson River Telephone Co., Supreme Court of New York.

ELECTRIC LIGHTING COMPANY MAY NOT DISCRIMINATE AS TO CHARGES.—Electric lighting corporations are quasi-public corporations, that is corporations which partake of the nature and attributes of public corporations, and they are, therefore, bound not to discriminate among their customers in the matter of charging for light furnished but must supply light upon terms common to all. Where a consumer has paid for light at a rate higher than that at which other consumers were charged, he may, upon discovering the overcharge, recover the same in an action, inasmuch as the excess was paid under a mistake of fact. The general rule is that money paid under a mistake of fact is recoverable, whereas money paid upon the misapprehension of a legal right is not. Armour Packing Company vs. Edison Electric Illuminating Company, Supreme Court of New York.

WHAT THE LAW DEMANDS OF TELEPHONE COMPANIES.—Every telephone company impliedly undertakes to exercise at all times the highest degree of care and diligence to protect its subscribers from a dangerous electric current over its wires from any source, and in towns and cities threaded with high-tension electric wires it is the duty of a telephone company, by constant supervision of its wires, to prevent their becoming conductors of dangerous currents from other wires. A telephone company is not an insurer of its patrons against injury, but when an accident results from the transmission of a dangerous current, that in itself is reasonable evidence of negligence on the part of the company, and, while the law will not hold it responsible for what it cannot help, the burden is upon the company to show why it should be relieved from liability. Delahunt vs. United Telephone & Telegraph Company, Supreme Court of Pennsylvania.

TELEPHONE LINE NOT AN ADDITIONAL BURDEN ON THE HIGHWAY IN ALABAMA.—A recent Alabama case holds that a telephone line is not an additional servitude upon the highway along which it runs and that the abutting owners are not entitled to compensation for the erection of such a line. The Court regarded the erection of telephone lines as the accomplishment of one of the great purposes for which public roads are dedicated. The fact that it will be necessary to cut down trees does not warrant the granting of an injunction restraining the telephone company from further work until the trees are paid for. If the abutting owner has any right to compensation for the trees his proper remedy is an action at law for damages. Only a minority of the United States adhere to the rule that a telephone does not constitute an additional burden upon the easement. New York, New Jersey, Illinois and many other jurisdictions maintain the opposite view and, in such a case, allow compensation to the abutting owner. Hobbs vs. Long Distance Telephone & Telegraph Company, Supreme Court of Alabama.

LIABILITY FOR LOSS OF BUILDING BY FIRE.—The owner of a barn was allowed to recover from a telephone company damages for the destruction of the building by fire where the jury determined from the evidence in the case that lightning struck the defendant's main line and was conducted along the defendant's wires to the plaintiff's barn. The pole nearest the barn was guyed to that building by a piece of ordinary telephone wire which was not fitted with lightning arresters, circuit breakers or any other device that might have protected the structure. Expert testimony was given on both sides as to whether or not the failure to insulate the guy wire amounted to negligence. It was held that, although a telephone company was not obliged by law to guarantee the safety of its system under all possible conditions and circumstances, it was nevertheless bound to exercise that due and ordinary care which the present state of scientific knowledge would suggest as reasonably necessary for the protection of life and property along its line; that there was a failure of duty in this respect; and that the defendant was, therefore, liable. Wells vs. Northeastern Telephone Company, Supreme Judicial Court of Maine.

LIABILITY FOR DEATH RESULTING FROM CONTACT WITH TELEPHONE.—In an action brought against a telephone company by the children of a subscriber to recover damages for the death of their parent, which resulted from an electric shock received while the deceased was using the telephone on his premises, it appeared that the deceased's telephone had become disconnected during a storm and had been allowed by the company to remain disconnected for a period of several weeks. The company had written to the deceased informing him that the telephone would shortly be put into working order. On the evening of the accident a noise resembling that of a cricket was heard coming from the direction of the telephone. The deceased, believing that the sounds signified that the connection had been restored, stepped to the telephone and seized the transmitter to draw it down within reach. As he did so there was a flash of flame all around the telephone and he was almost instantly killed. It later turned out that the uninsulated wire running from the deceased's house had become crossed with the heavily charged wires of another company, thereby conducting the current to the telephone and causing the noise mentioned. The transmitter being made of metal and the carpet near the telephone being wet, the deceased received the shock which caused his death. It was decided that the deceased was not guilty of contributory negligence in acting as he did. The telephone company was held to have been negligent and, therefore, liable in damages for the death. It was declared unnecessary to prove specific negligence on the part of the telephone company for the reason that the case came within the legal maxim "Res ipsa loquitur"—(the thing speaks for itself), Delahunt v. United Telephone & Telegraph Co., Supreme Court of Pennsylvania.

FOREIGN CORPORATIONS IN ILLINOIS.—The Illinois Supreme Court has just handed down a decision which will very widely affect business interests and it will involve many an eastern manufacturer maintaining branch houses within the state. This matter, brought to our attention by Mr. Frederic P. Vose, of Chicago, attorney for the Electrical Trades Association, is the case of the United Lead Company vs. Elevator Manufacturing Company, 222 Ill. 199, and relates to the restrictions placed upon foreign corporations under the laws of 1899. The court now holds that all attempts of a foreign corporation which has not first complied with this law to transact business of whatsoever kind and nature in this state are absolutely without effect, and any contract entered into within this state, without having first complied with the law, is in violation of the plain provisions of the statute, and therefore null and void and no action can be maintained thereon at any time, even if the corporation should at some time after the making of the contract qualify itself to transact business in Illinois by compliance with the laws in reference to foreign corporations that desire to engage in business within this state. The effect of this decision is very far reaching. Heretofore the trial judges generally have interpreted the foreign corporation act of Illinois in the light of the decisions that have been handed down by the Supreme Court of Missouri, from which latter state, Illinois borrowed the phraseology embodied in its foreign corporation act. The decision of the Missouri courts were to the effect that a foreign corporation could institute a suit to recover the purchase price of goods sold, although the corporation had not complied with the foreign corporation act, provided it did comply before the termination of the action. This gave the foreign corporation the implied right to do business, which could not be abridged, if at any time the corporation complied with the act. This Illinois decision, however, completely wipes the slate of all business, contracts and engagements entered into by a foreign corporation maintaining a local branch within this state, and prohibiting absolutely the right of the corporation to trade at all. In this case it was contended that a foreign corporation's right to bring an action in the courts of this state was not barred by these statutes, which merely had the effect of abating the action, leaving to the foreign corporation the right to maintain its action if it should, after institution of the suit, qualify to transact business in this state, by compliance with the act. This contention, which heretofore has been held to be the correct interpretation of the law, is now flat-footedly denied. The effect of this decision is that all corporations organized outside of Illinois, but maintaining branches in that state, must forthwith comply with the act, if they have not already done so; otherwise they are bound hand and foot by this decision.

Personal.

MR. H. S. SHANE, general manager of the Webster, Mass., Electric Company, has become general manager of the Southbridge, Mass., Gas & Electric Company.

MR. H. B. KIRKLAND has resigned his position as general sales manager of the American Circular Loom Company of Chelsea, Mass., and is no longer connected with that corporation.

MR. COURTENAY CROCKER has begun the practice of the law in Boston in the office of Moody, Burdett, Wardwell & Snow, a legal firm well known in connection with electrical and other corporate interests in New England.

MR. GEORGE W. WILDER, Ph.D., has resigned his position as professor of telephone engineering at the Armour Institute of Technology and has opened an office in the Monadnock Building, Chicago, as a telephone engineer.

WEAVER-JONES.—On Oct. 20, Miss Leonara Jones, daughter of Mr. and Mrs. Francis Wiley Jones, was married in New York City to Dr. George E. Weaver. The father of the bride is well known as chief electrician of the Postal Telegraph Cable Company. Dr. and Mrs. Weaver will be at home at the Marion, upper Broadway, after Nov. 1.

MR. N. R. BIRGE.—It is stated that Mr. Nathan Birge has been appointed manager of the factory arc light department of the General Electric Company. Mr. Birge is the oldest son of the late Senator John Birge, who was killed a year ago. He graduated from the Bristol High School and the Worcester Polytechnic Institute. As soon as he had concluded his technical education he took a position with the General Electric Company.

MR. W. H. BLOOD, JR., 84 State Sreet, Boston, has been retained by the National Electric Light Asecciation as insurance expert in the interests of the members. Any member companies having insurance troubles would do well to call upon Mr. Blood for services that will undoubtedly be of great assistance and will be promptly rendered. Mr. Blood was president of the Association last year.

MR. R. L. WARNER.—Mr. Robert L. Warner, former New England manager of the Westinghouse Electric & Mfg. Company, and Randolpu F. Tucker, for many years with Vermilye & Co. and Mackay & Co., have formed a copartnership as Warner, Tucker & Co., with offices at 35 Congress Street, Boston, to deal in investment securities. The new firm will be the Boston correspondents of Redmond & Co., of New York.

MR. R. F. SCHUCHARDT, formerly in charge of the engineering testing department of the Chicago Edison Company, became, on November 1, engineer in charge of electrical construction for that company. His successor in the testing department is Mr. E. O. Schweitzer. Electrical construction work was formerly looked after by Mr. Edward Schildhauer, who was recently appointed assistant engineer to the Panama Canal Commission, as noted in these columns.

MR. GEORGE BULLOCK has been elected President of the United Gas and Electric Company of New Jersey. He was formerly president of the South Covington & Cincinnati Street Railway. He was president of the Cincinnati Edison Electric Light Company, a director of the Cincinnati Street Railway Company and of the Cincinnati Gas Company, and acting president of the Bullock Electric Manufacturing Company, which was acquired by the Allis-Chalmers Company.

PROF. W. L. PUFFER, so well known through his connection for many years past with the electrical engineering laboratories of the Massachusetts Institute of Technology, has resigned, and will hereafter conduct an office as consulting electrical engineer at 307 Equitable Building, Boston. His work in connection with insurance questions, formulation of underwriters' rules, etc., has been of the most valuable and useful character, while his laboratory experience is practically unsurpassed in this country.

MR. JOSEPH B. BAKER, the consulting eelectrical engineer and technical journalist, who has been associated for the past two years with the publication bureau of the General Electric Company, has accepted the position of technical editor of the Government Fuel Testing Plant at St. Louis, which has a great deal of valuable and interesting data and literature to make public in the near future. The work of this plant is being continued, and, it is understood, will probably be resumed at the Jamestown Exposition. Mr. Baker will have the opportunity to be extremely useful to his fellow engineers in all the fields of fuel consumption, and the opportunity is worthy of his ability.

MR. A. J. MARSHALL.—The illustrated lectures which Mr. A. J Marshall, illuminating engineer of the Holophane Glass Company, is giving before the central stations and gas companies on the question of light and illumination are proving very successful, and it is expected that this work will be the means of greatly assisting the growing demand for the best kind of lights properly placed for desired effects. Mr. Marshall lectured before the West Penn Electric Company, Connellsville, Pa., on Thursday evening, Oct. 25, at which an enthusiastic audience displayed great interest. The Holophane Glass Company states in this connection that, while this lecturing is planned for some time ahead, it will, nevertheless, be pleased to consider applications for this kind of service and deliver lectures in the order that requests are received.

MR. WALTER G. CLARK, formerly of Seattle, Wash., who has for the past two years been engaged in advancing the interests of the Ansonia Brass and Copper Company along electrical lines, has completed his contract with this company and opened offices at 135 Broadway, New York City, which offices will also be the headquarters for several electrical interests with which Mr. Clark is associated. Among them are the Parker Clark Electric Company, which is maintaining extensive research laboratories and has secured a number of important patents in the electrical field. The offices will also be the headquarters of the Clark Electric and Manufacturing Company, which is manufacturing rail bonds, splicing sleeves and a line of insulators, clamps and equipment for high potential transmission service covered by patents issued to Mr. Clark.

PROF. F. A. GOETZE.—At a meeting of the trustees of Columbia University, New York City, held last week, Frederick A. Goetze was appointed Dean of the Faculty of Applied Science. Mr. Goetze has been the superintendent of buildings and grounds for seven years. He will replace Prof. George F. Sever, who has served as acting dean since the retirement of Prof. Hutton, in July, 1905. The appointment marks a radical step in the administrative policy of the university, as it shows the tendency of the authorities to sever the office of dean from the work of teaching. Prof. Sever was forced to retire because the administrative work did not leave him enough time to attend to his duties as a professor. The new dean will deliver no lectures, but will confine himself entirely to the executive work of the School of Applied Science. He will assume his new duties on Jan. 1. Henry Lee Norrin, now an assistant to Mr. Goetze, was appointed to succeed the latter as superintendent of buildings and grounds.

Obituary.

CAV. M. MICHELA.—Announcement reaches us of the sudden death of Cav. Mario Michela, in Rome, Italy, on October 10. He was president of the Societa Italiana di Elettrochimica, which has a large plant of several thousand horsepower for the electrical production of caustic soda and bleaching powder, and operates other chemical plants in Italy.

MR. G. HERRING.—It is cabled from London that Mr. George Herring, the noted English philanthropist, who in the course of his life contributed large sums of money to hospitals and charitable enterprises, died there last week after an operation for appendicitis. He made his first money on the race courses, and subsequently became identified with a number of large businesses. He was a chairman of the City of London Electric Lighting Company, Electric & General Investment Company, Municipal Trust Company, and several mining companies.

News of the Trade.

THE LINK-BELT COMPANY has recently opened an office at No. 913 Missouri Trust Building, St. Louis. Mr. E. C. Berghoeffer, an engineer of long experience with the Chicago house of the company, is in charge.

MESSRS. R. J. BELL and W. E. Rafferyt, of Oklahoma City, announce that they have opened up offices at 118 North Broadway, that city, as electrical engineers under the firm name of the Independent Electrical Construction Company. They desire catalogues, price lists and other data from manufacturers of and dealers in electrical supplies and appliances. also from manufacturers of engines, boilers, pumps, etc.

THE NEW YORK CENTRAL RAILROAD is placing further orders with the Electric Cable Company, of 17 Battery Place, New York, for Voltax, the liquid compound to be used as an insulating and waterproofing material in connection with the third-rail system near High Bridge, New York. This material has done excellent service as an insulating compound and is becoming extensively used for this purpose. Among the large concerns which are using Voltax for this purpose are Westinghouse-Church-Kerr & Company, who are using it on galvanized cables; the Interborough Rapid Transit Company, which is using it as a waterproofing material on its galvanized sheds and out-houses; and the American Insulating Machinery Company, of Philadelphia, which is using it on the frame work of its insulating machines.

I. P. FRINK.—A system of window illumination that has been adopted by every big department store in New York City must of necessity have established a claim to all the desirable elements in that most important field. Frink's special patent window reflector is the device which has this enviable record. To it as a factor is credited the brilliant appearance of the retail centers in cities and towns throughout the country. Some recent orders were for lighting the show windows of B. Altman & Co., Jas. McCreery & Co., Lord & Taylor, New York City; The May Company, Denver, Col.; Watt, Rettew & Clay, Roanoke, Va.; H. Astrich, Harrisburg, Pa.; Hutzler Bros., Baltimore, Md.; W. D. Kinsman Company, Springfield, Mass.; D. J. Donahue Company, Missoula, Mont.; M. S. Plaut Company, Danville, Ill.; Sibley, Lindsay & Carr, Rochester, N. Y.; Julius Sycle Sons, Richmond, Va. Central stations and contractors who are after new business have found the line of reflectors of I. P. Frink, 551 Pearl Street, New York, a material aid to their efforts. These reflectors are becoming better known by a very thorough campaign of advertising to the possible users, all of which is a direct benefit to the electrical trades and central station interests.

Trade Publications.

ELECTRIC PORTABLES.—A well-prepared bulletin describing Almond electric portables and flexible arms has been issued by the T. R. Almond Mfg. Company, 83 Washington St., Brooklyn, N. Y.

BLUE PRINTING MACHINES.—A brief description of an apparatus for making blue-prints by electric light at any time during the day or night regardless of weather conditions is to be found in a catalogue recently issued by the Buckeye Engine Company, Salem, Ohio.

ELECTRICAL MEASURING INSTRUMENTS.—A full line of alternating-current and direct-current ammeters, voltmeters and watt-meters is described in a catalogue and price-list issued by the Whitney Electrical Instrument Company, through its sales agents, Machado & Roller, 203 Broadway, N. Y.

HIGH PRESSURE BLOWERS.—Catalogue No. 140 of the B. F. Sturtevant Company, Hyde Park, Mass., gives an interesting discussion of high-pressure blowers for creating pressures up to ten pounds per sq. in. In addition to describing and illustrating the blower, the catalogue contains much valuable information concerning the measurement of volume, pressure and power at pressures of from 1 to 10 lbs. per sq. in.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCT. 30, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

834,272. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed Dec. 29, 1902. Relates to a complete cord circuit for a telephone system.

834,274. ELECTRIC PUMP GOVERNOR; Edward H. Dewson, Edgewood Park, Pa. App. filed Aug. 22, 1905. The reservoir pressure is balanced against a spring together with an electromagnet and devices are provided to adjust the strength or holding power of the electromagnet to meet different conditions of service. The relative position of the magnet poles is adjustable for this purpose.

834,302. TROLLEY WHEEL; Henry L. Humphrey, Monroe, Mich. App. filed Nov. 13, 1905. The trolley wheel axle has a globular part on which the wheel is received so as to be capable of lateral as well as rotary motion.

834,352. CASE FOR LOADING COILS; Henry F. Albright, New York, N. Y. App. filed Apr. 22, 1905. The loading coils are contained in specially constructed oil filled casings at intervals along a conduit so as to balance the capacity of the telephone wires therein.

834,355. MAGNETIC POWER CONTROL; Daniel Bacon, Brooklyn, N. Y. App. filed Jan. 28, 1905. A form of magnetic clutch designed to reduce heat and wear between the magnet and armature. Has an adjustable ball bearing between the magnets and armature so as to adjust their separation.

834,392. STRAIN INSULATOR; George A. Mead, Mansfield, O. App. filed Apr. 22, 1905. One of the eye bolts has an outwardly projecting flange and the other an internal flange and a porcelain bushing is contained between the two so as to be subject to compression strains.

834,404. SIGNALING SYSTEM; Frank B. Rae, Ridgewood, N. J. App. filed Aug. 5, 1901. An arm projects laterally from the usual trolley harp and has a wire bail spring pressed upward therefrom which contacts with a special trolley wire for signal purposes.

834,424. RESISTANCE DEVICE; William L. Waters, Milwaukee, Wis. App. filed Apr. 28, 1905. A sheet metal casing is filled with oil and has rows of laterally supported rods between which are strung the spiral coils constituting the resistance element.

834,480. COIL FORMER; Julius W. Lundskog, Lynn, Mass. App. filed Mar. 25, 1904. In order to avoid splicing together the coil sections of an armature winding, patentee provides a special former having separate plates arranged in echelon, so that all of the coil sections may be wound at one time on the former.

834,496. OSCILLATING CURRENT LAMP; James E. Seeley, Los Angeles, Cal. App. filed July 12, 1905. The secondary winding of an air transformer for high frequency discharge is wound spirally and forms a part of the lamp casing.

834,497. TRANSMITTING APPARATUS; Harry Shoemaker, Jersey City, N. J. App. filed Jan. 2, 1906. In order to avoid excessive acting at a telegraph key, patentee provides a magnet which keeps the key depressed until the circuit potential is such that injurious sparking will not occur.

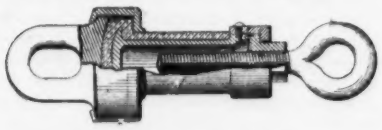
834,520. SOUND MAGNIFIER FOR TELEGRAPH INSTRUMENTS; Frederick O. Hanson, Victoria, Kan. App. filed Feb. 26, 1906. Patentee has a membrane connected by a multiplying lever with the relay contacts so that the click is intensified and a sound reflector is connected to focus the sound to the operator.

834,525. VOLTAGE REGULATOR; Ray P. Jackson, Wilkinsburg, Pa. App. filed June 12, 1905. In order to handle large currents without injurious arcing, patentee provides a plurality of inductive windings so arranged that a plurality of spaced leads from a main transformer are utilized simultaneously through a multitude of switch contacts.

834,533. INSULATOR; James F. Nicols, Plainfield, Ark. App. filed Sept. 11, 1905. Two semi-cylindrical blocks are channeled to fit upon the line wire and are held in relation by a clamping plate and lag screws.

834,538. SYSTEM AND APPARATUS FOR MEASURING TELEPHONE SERVICE; Harold D. Stroud, Chicago, Ill. App. filed May 13, 1904. Provides means actuated by the telephone user to cause the registering device to charge a call.

834,563. ELECTRIC MOTOR CONTROL SYSTEM; William Cooper, Wilkinsburg, Pa. App. filed May 22, 1905. Provides an auxiliary control system in connection with means for automatically changing from a series connection of the motors to a multiple connection without involving an increase or diminution of the motor currents.



834,392—Strain Insulator.

834,567. INSULATOR; Richard A. Falkenberg and Solomon S. Simon, San Francisco, Cal. App. filed Aug. 29, 1905. A bell shaped insulator is laterally channeled in a zig-zag way so as to receive the circuit wires and hold them against displacement.

834,570. SYSTEM OF TRANSMITTING POWER; George P. Finnigan, Greene, N. Y., and George T. Hanchett, Hackensck, N. J. App. filed Aug. 30. 1905. A form of motor for operating railroad signals and devices requiring large power for a short time at occasional intervals. A pair of magnets have solenoids with friction pawl connections to a rotating part and a specially constructed switch is arranged to alternately energize these magnets.

834,575. PRECIPITATING-CELL; Wilbur A. Hendryx, Denver, Colo. App. filed Jan. 17, 1906. A precipitating-cell comprising a frame, a filtering medium carried thereby, supports for said filtering medium, precipitating means within said frame, and deflecting side plates interposed between the filtering medium and the precipitating means, substantially as described.

834,582. CONTROLLING DEVICE; Benjamin G. Lamme, Pittsburg, Pa. App. filed Jan. 3, 1905. In combination with a source of alternating current, source of direct current, a translating device adapted to make connections with either source, and means for interrupting the connections when the character of energy supplied is not suitable to the translating device.

834,597. ELECTRIC CURRENT INTERRUPTER; Julius B. Wantz, Chicago, Ill. App. filed Nov. 22, 1905. Circuit interrupter designed particularly for therapeutic instruments where it is desired to have different periodicities constant at any particular time. A clock train drives a mechanical interrupter and a governor is effective to regulate the speed.

834,626. UNLOADER FOR SINGLE ACTING COMPRESSORS; Frederick Van D. Longacre, New York, N. Y. App. filed Nov. 23, 1904. A ball valve is normally held against its seat by a solenoid magnet which allows the valve to open when de-energized.

834,644. PROCESS OF TREATING ORES; Frederick T. Snyder, Oak Park, Ill. App. filed June 21, 1905. Details of process of treating mixtures of ores in an electric furnace.

834,656. METALLURGICAL PROCESS FOR THE EXTRACTION OF METALS FROM THEIR ORES AND THE CONVERSION OF IRON INTO STEEL; George H. Benjamin, New York, N. Y. The herein-described process which consists in first reducing the ore, then introducing a combining body, then subjecting said bodies while in motion to the effects of an electric arc.

834,659. TELEGRAPH CUT-OUT; Fred A. Clogston, Bridger, Mont. App. filed Nov. 11, 1905. A special construction of switch having a casing with knobs which are turned to cut in and out the various sounders of the station.

834,559. TEST AND WIRE CONNECTOR; William A. Fricke, Chicago, Ill. App. filed Oct. 24, 1904. A bolt is longitudinally slotted so that the wires to be connected may be passed through the slot and pressed against one another by the nuts and washers.

834,684. CONNECTOR FOR CONDUITS FOR ELECTRIC WIRES; Clarence C. Sibley, Perth Amboy, N. J., and George A. Lutz, New York, N. Y. App. filed July 18, 1904. A special form of connection adapted to connect sheet iron telephone conduits with an outlet box. The sheet iron conduits are expanded into this connection so as to be permanently fastened thereto.

834,685. CONDUIT FOR ELECTRIC WIRES; Clarence C. Sibley, Perth Amboy, N. J., and George A. Lutz, New York, N. Y. App. filed Oct. 26, 1905. A form of sheet iron conduit box having a cover plate and metallic straps to hold the cover plate on the box.

834,686. BASE FOR SUPPORTING SWITCHES AND THE LIKE UPON CONDUITS; Clarence C. Sibley, Perth Amboy, N. J., and George A. Lutz, New York, N. Y. App. filed Oct. 26, 1905. Relates to a wall switch having a circular base with special metallic parts for the adjustment of the circuit wires.

834,687. ELBOW FOR CONDUITS; Clarence C. Sibley, Perth Amboy, N. J., and George A. Lutz, New York, N. Y. App. filed Oct. 26, 1903. Relates to an elbow or ground for a sheet iron telephone or wiring conduit.

834,689. RAIL BOND; Charles R. Sturdevant, Worcester, Mass. App. filed July 7, 1905. A process of attaching a specially formed bond to a rail. The bond is positioned in a cavity of the rail, then the rail is indented with a cold chisel and the bond is finally hammered down.

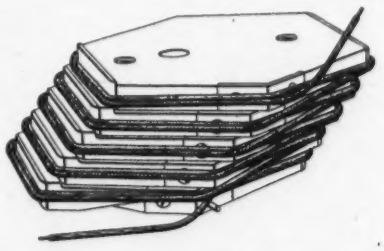
834,690. RAIL BOND; Charles R. Sturdevant, Worcester, Mass. App. filed July 7, 1905. Relates to modification of the above, and particularly to form of tool for pressing the bonds into engagement with the rail.

834,708. SECONDARY ELECTRIC CLOCK; Henri Campiche, Geneva, Switzerland. App. filed May 24, 1905. Mechanical features designed to secure a positive movement of the clock solenoids and to prevent their over-throwing, or displacement by the high winds.

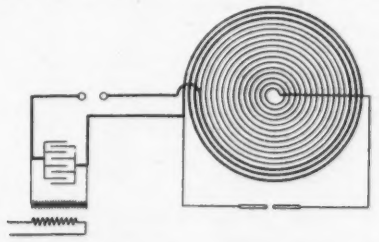
834,742. CONDUIT FOR ELECTRIC CONDUCTORS; George A. Lutz, New York, N. Y. App. filed Oct. 26, 1905. A sheet metal conduit has rabbitted upper edges which receive a slidable strip constituting a cover.

834,750. VOLTAGE REGULATOR; Thomas M. Pusey, Kennett Square, Pa. App. filed July 9, 1904. An electric motor has a double worm reduction gear with a rheostat arm.

834,755. ELECTRIC LIGHT BATH CABINET; Harvey H. Roberts, Lexington, Ky. App. filed Apr. 5, 1906. The cabinet has a chair with vacuum tubes for a static discharge, and has a bank of red, white and blue lamps.



834,480—Coil Former.



834,496—Oscillating Current Lamp.

834,764. PROTECTIVE APPARATUS FOR RAILWAY TELEPHONE SETS; Charles E. Scribner, Jericho, Vt. App. filed Oct. 21, 1904. Has means operated by the closure of a circuit by abnormal currents therein for opening the circuit and dissipating the abnormal current.

834,828. JUNCTION OR OUTLET BOX; George A. Lutz, New York, N. Y. App. filed Sept. 14, 1905. Relates to a cross or tee for joining together intersecting sheet metal wiring conduits. The connection has tongues which are received in corresponding holes of the conduits.

834,829. MEANS FOR HOLDING RECEPTACLES AND THE LIKE TO CONDUITS; George A. Lutz, New York, N. Y. App. filed Sept. 14, 1905. A sheet metal conduit has a slidable strip constituting a cover and a porcelain casing has lugs which are received in the conduit so as to hold the casing in place and constitute a rosette or outlet therefor.

834,832. MEANS FOR CHARGING STORAGE BATTERIES OF TELEPHONE SYSTEMS; Talbot G. Martin, Chicago, Ill. App. filed Feb. 3, 1905. An automatic telephone system comprising a trunk line extending between two automatic exchanges, a storage battery at one automatic exchange, a source of charging-current at the other automatic exchange and a normally closed charging-circuit including said battery and source of current and a conductor of said trunk line.

834,869. TELEPHONE SIGNALING APPARATUS; William E. Butler and Morgan L. Lane, David City, Neb. App. filed Jan. 3, 1906. Has a revoluble member with annular segments arranged in a special way and contacts co-operating therewith for signaling purposes.